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A Mosaic of the Milky Way

By LATIMER J. WILSON

A photographic mosaic (Plate IV), assembled from star fields of the Milky Way and adjacent regions, obtained with a 3-inch lens shows the galaxy as it appears from the Northern Hemisphere. The interval involved extends from June, 1931, to December, 1932. Exposures generally ranged from 30 to 35 minutes; the Lambda Tauri field, showing planetoid Vesta, represents an exposure of 15 minutes. Ortho plates, size 4x5, of 1400 H&D, were employed in all except the field containing the Pleiades. This negative is a film having about the same speed as the plates.

Stars down to about the twelfth magnitude appear on the negatives. The assembled prints are not intended for study of individual stars, but to show the relations of masses of stars in continuity. The larger nebulae and dark obscurations can be discerned. In general a gradual increase in width of the galaxy can be detected from Auriga to Sagittarius. Here is located the probable center of the galaxy.

M31, the great nebula of Andromeda (a spiral nebula), and M33, in Triangulum, appear. The isolated remote star cloud NGC 6822 is not shown, but its location below the galactic center is roughly indicated.

The 3-inch lens is of the Petzval type adapted to give a field about 30x30 degrees on the small plates with full aperture f2.3. Sky fog is apparent in the Perseus and Taurus fields.

FRANKLIN, KENTUCKY.

The Astronomical Fraternity of the World

By DAVID B. PICKERING

PART XII

On Santa Barbara street in Pasadena stands the classical structure that is referred to locally as "The Observatory." It contains the executive quarters, the library, and the staff offices of the Mt. Wilson Observatory. Set in the lawn at its front, a row of poplars parallels the broad façade of this two-storied building. A private roadway from the street, passing the eastern end of this edifice, extends to the so-called "Brick Building" in the rear, wherein Professor George Willis Ritchey worked during war times upon prisms and lenses for the government. There Dr. Harold D. Babcock now conducts his high dispersion spectroscopic investigations and there also Mr. Wendell Phillips Hoge has his office. Above stairs each Wednesday morning at 11:00 o'clock, members of the

FIGURE 1.
ADMINISTRATION BUILDING, MT. WILSON OBSERVATORY, PASADENA, CALIFORNIA.

staff gather to hear a discussion by one of their number. Separated from the administration building only by the private roadway stands the Optical Shop and next to that the Physics Laboratory, all forming a conveniently arranged group, each of which contributes its important share to astronomical research.

It was April 14 of last year, and but two days after our return from Mt. Wilson, when I called at Santa Barbara street. Upon entering the main building one crosses a wide hall paralleling the street, lined with doors leading to many of the staff offices. Across the hall, opposite the entrance to the building, is the library. Beneath a window at the western end of the hall a complete miniature model of the observatory buildings on Mt. Wilson is displayed. Upon a stand in the hall at the left of the library doors is a realistic bust of Professor Albert Einstein, the work of a local sculptor. The library, a large, softly-lighted room, is hung with life-sized portraits of those who have been intimately associated with the affairs of the observatory. That of Dr. George Ellery Hale faces the entrance.

Upon inquiring for Dr. Paul W. Merrill I was directed to his office on the floor above. Dr. Merrill, as an honorary member of the American Association of Variable Star Observers, has long been one of its sympathetic advisers. He came to Mt. Wilson in 1919 from Washington where he had served the government during the war. I was surprised to find him so young a man. Just why one is always expecting great age, white beards, and faltering limbs in those scientists of whom he has heard much we cannot say, unless it is that one's own years are mounting so rapidly that he cannot realize that subsequent generations are "arriving." Though the "iron" is creeping into Dr. Merrill's hair, he cannot be over forty. He is slender, sharp-featured, and vivacious. He welcomed me to Headquarters and we inevitably drifted into a discussion of variable stars, the A.A.V.S.O., its people and their work, and Dr. Merrill's own study of the subject.

Among other things he expressed the hope that investigators of stellar variability would give more weight in their discussions to the remarkable velocities of the long-period variables. He feels strongly that these must in some way be related to the phenomena of their light changes. He urged that amateur observers be encouraged to introduce every detail of deviation noticed into their light curves, perhaps, if possible, using photographic means to secure these. He feels that any slight deviation from the mean curve would be significant. He thought that rather too much attention had been given to statistics by those attempting to picture the course of a star's evolution.

Professor Einstein had left California only a week or so before our arrival and it was interesting to hear Dr. Merrill, who had much to do in caring for the great mathematician, recount some of his experiences. It was good to learn that those ardent scientists of Pasadena found no fly in the Einsteinian ointment, that they considered his reasoning always

sound. That he was convinced of his conclusions though hesitant in stating them, was expressed thus by Dr. Merrill: "He *thinks* fast and true, but *speaks* slowly and surely." After giving me reprints of those four comprehensive papers of his on variable stars, published in POPULAR ASTRONOMY in 1929 and 1931, Dr. Merrill took me to the office of Dr. Gustav Stromberg. Like many of the staff whom I was yet to meet, here was another entering that period which might be designated as young middle-age. Short and stocky and betraying his Swedish lineage,

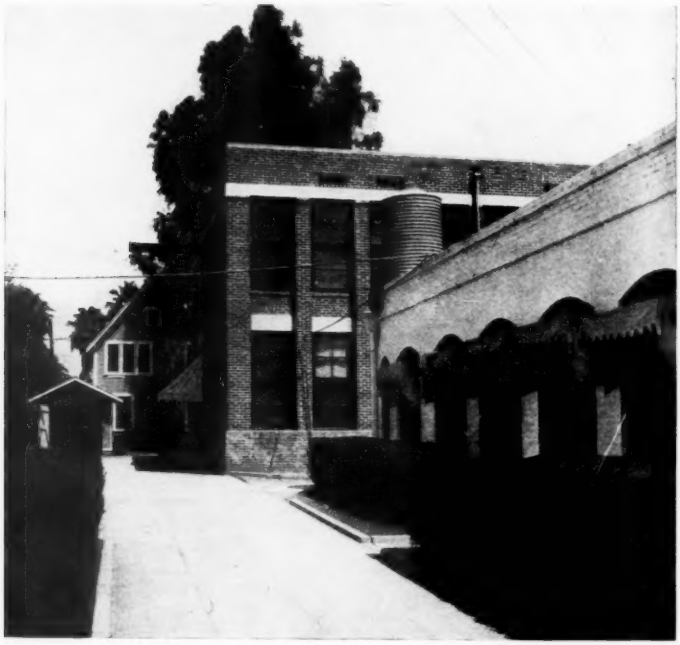


FIGURE 2.
THE BRICK BUILDING. OPTICAL LABORATORY AT RIGHT.

this eminent mathematician who joined the Mt. Wilson staff in 1916, devotes himself largely to the study of stellar motions. His graphs expressing the courses and speeds of the stars invite speculative dreams. One blueprint that he showed us depicted the massive A and B stars grouped at one end of a sweeping velocity curve, while far out in the direction of greater speed came the M stars, variables with periods of 300 to 350 days. Farther still were the Cepheids and farthest of all were those variables with periods of 150 to 200 days. Somewhere far off, if the curve were sufficiently extended, would be the mysterious spiral nebulae. Another design was a trefoil representing the orbit of a

theoretical star in a regularly distributed cluster. Herein the forces of all the stars would cause one complete perihelion revolution in every three orbital periods of the theoretical star. Here indeed was rare fodder for the imagination.

Out again in the corridor we met Dr. A. H. Joy, who is also in the young-middle period of life, sandy-haired, smiling and cordial. Dr. Joy came to Mt. Wilson a year before the arrival of Dr. Stromberg, after having spent several years in Beirut, Syria. He is Secretary of the Observatory, and his work deals with spectrum analysis and radial velocities. There also I was introduced to Dr. Saunders and Mr. Adams, the latter a cousin of the Director.

It was in Europe, in 1928, that I had first met Dr. Edwin P. Hubble, to whose office on the main floor Dr. Merrill now conducted me. There, at a desk upon which pipes and tobacco broke promiscuously into the society of spectrograms, photographs, and scientific papers, sat that distinguished but debonair professor. Though Dr. Hubble's appearance would lend atmosphere to a Hollywood studio, the scientific world studies his pronouncements with keen interest. After Dr. Merrill had left us, our talk soon fell upon variable stars and Dr. Hubble showed me several plates of a region in the southern sky whereon were shown variable nebulae similar in character to that of R Monocerotis. In the same field was a new variable of which he was desirous of securing observations. He speculated upon the advantages of comparing nebulae with diffused star images as a better means of ascertaining the brightness intensity of the former, and displayed drawings of a nebulous frame-work across which obscuring matter appeared to be passing. One of the plates I was about to examine slipped from my hand and was broken and Dr. Hubble, though probably cursing me inwardly, remained graciously unperturbed. It was late afternoon, and Dr. Hubble, before more of his equipment was destroyed, decided to call it a day, and closing his office walked with me to the street. Dr. Hubble carried a cane, and I hope it was his regular habit. There are two kinds of men: those who love to carry canes and those to whom canes are anathema. I like carrying a cane because it gives me something to do with my hands during their enforced idleness—and my age silences the scoffers. Outside the building we met Mr. Ferdinand Ellerman, characterized by his iron-gray Van Dyke beard and wearing a few more years than some of those whom I had met during the day. Mr. Ellerman had been associated with Dr. Hale in the early days of the Kenwood Observatory. His forte, naturally enough, is solar research. I noticed him the next day with a billiard cue in his hand and, having previously seen a picture of him playing billiards, might not be wrong in hazarding a guess that this was his chief indoor sport.

I had the pleasure of driving Dr. Hubble to his picturesque home in San Martino, a suburb of Pasadena, so ending another memorable day.

Upon visiting the "Observatory" again next morning, I met Profes-

sor A. S. King, Director of the Physics Laboratory, who was just about to enter his office. I remembered his quiet kindliness, his slender figure and gray-crowned face from our former meeting in Leiden. I accepted his invitation to inspect the Laboratory. Here, in a moderately sized enclosure, were countless instruments for investigation. Near the center of the main room a 30-foot pit, dropped below the surface of the floor, was used in connection with a spectroscope having an 8-inch mirror. The element being studied is placed in a tube of pure carbon and heated by a furnace capable of raising its temperature to 3500° C. The gas from the white-hot element is then examined spectroscopically. With the means there employed they are able to ionize many of the elements and to show their absorption lines.

Professor King introduced me to Dr. Sinclair Smith, his associate, who, I believe, is the youngest member of the Mt. Wilson staff. Dr. Smith showed me many of the other mysteries of the laboratory, including certain of his own minute, delicate instruments for measuring radiation. In one part of the building we came upon two visiting Japanese physicists engaged in some special research, and I was introduced to Professor Nagaoka, Director of the Institute of Physical and Chemical Research of Tokyo, and his confrere, Professor Takamine. Dr. Smith then took me through the Optical Laboratory and the Tool Shops. In the former we saw one of Professor Elihu Thompson's early quartz mirrors and the 60-inch testing flat and great polishing disc employed by Professor Ritchey in constructing the 100-inch mirror. It was interesting to see the many laps used for rough grinding and polishing optical discs.

Among the many mechanical devices in the Tool Shops, perhaps the most intriguing was that for engraving diffraction gratings. Dr. Smith said that no attempt had yet been made to extend the size of these beyond 8-inches. It seems that each member of the staff attends personally to the making of any particular grating for which he may have need. I was sorry to have missed seeing the guiding genius of this little mechanical world, Dr. John A. Anderson, formerly of Johns Hopkins, who had worked on gratings with Roland. It was he who had devised that double prism pencil for Dr. Hale's spectrohelioscope. At the time I was there Dr. Anderson was head of the committee charged with preparing the way for the proposed 200-inch telescope. On this committee he was associated, among others, with Hale, Millikan, Adams, and Porter. At eleven o'clock we went to the Brick Building for the regular Wednesday morning discussion. Walking between the Optical Laboratory and the main building we noticed a couple of coelostats standing unattended at the side of the path, controlled by wires coming from an open basement window. Dr. Smith explained that they were part of another of Dr. Pettit's numerous schemes for recording the sun's radiation in various sections of the spectrum. Arriving on the second floor of the Brick Building we found thirty or more members of the staff seated in

a double row about three sides of a modest-sized room, ready to listen to Dr. Joy's discussion of Cepheid variables. Dr. Joy's talk dealt with a study of 113 Cepheids with periods of from 2 to 45 days, and the relative advantages of high or low dispersion in determining their velocities spectrographically. He stated that the comparison of the velocity curve with the light curve of these stars showed the two in almost exact inverse relation. The argumentative discussion which broke into and followed Dr. Joy's talk was evidence of the interest aroused and of the various and often divergent views of the staff on the subject.

When Dr. Giorgio Abetti was visiting us the previous November, he had given us a friendly note to Professor Frederick H. Seares, the Assistant Director of the Mt. Wilson Observatory, and it was to present this that we had arranged to meet Professor Seares in the library in the early afternoon of the day of Dr. Joy's talk. This tall, cultured, middle-aged gentleman had that dignity and sedateness which one often expects to find in an astronomer, but so seldom does. His carefully arranged attire was in keeping with his exact manners and speech. I was not surprised to learn that he edits all of the observatory publications. He is Superintendent of the Computing Division and also has charge of star counts and stellar photometry. We had a pleasant chat and he gave us interesting advice upon our proposed tour of Southern California.

We found Dr. Edison Pettit in the library when we went there to meet Professor Seares. He was standing with ruddy face and tousled hair close over some book of reference. It must have bored him to greet casual visitors at that moment, but nothing in his cordial manner gave evidence of it. Mrs. Pettit happened to come in at the time, with their two daughters perhaps eight and twelve years old, and before the arrival of Professor Seares we had a pleasant visit with the family of this famous investigator of radiation.

Later we found ourselves again in the Brick Building where Mr. Hoge introduced us to Dr. Harold D. Babcock, slender, smiling, sharp-featured physicist, who shares with Mr. Clement Jacomini, the chief instrument maker, the responsibility of developing the large and efficient diffraction gratings which are such important factors in Dr. Babcock's investigations. A large part of the ground floor of the Brick Building is given over to Dr. Babcock and his "toys." Most prominent among these appeared one that resembled a white, grand piano. A piano of super-concert dimensions. This had been playfully named by the staff "The White Elephant." Others of Dr. Babcock's pets are called by such names as "The Black Baby" or "Uncle Sam's Pants."

It was in the investigation of the invisible infra-red spectrum that Dr. Babcock employed the peculiar device about which we then stood. From somewhere above us the sun's light was admitted through the roof of the building and allowed to fall upon a mirror which projected it through a lens making an image of the sun one or two inches in diameter. After encountering slit and grating somewhere in the "piano" the

beam reached a long box in the rear of the instrument wherein the spectrum was examined. With the high dispersion obtained spectrograms are made showing lines beyond 11,000 Angstroms. Dr. Babcock showed us comparisons of these spectrograms with some of Langley's bolometer graphs, the latter extending to over 20,000 Angstroms. Dr. Babcock had observed solar lines visually to about 8500 Angstroms and described the color of the latter as "muddy yellow." I don't recall that in our dreams that night we witnessed a procession of black and white monstrosities negotiating peaks and valleys of fever-chart curves, but well we might.

The next day found me again at the Brick Building in the pleasurable anticipation of having a glimpse at those old "Logs" of which Mr. Hoge had told me and which I begged him to allow me to see. We sat in his snug office whose partition extended just to the corner of the "White Elephant" (or was it "Uncle Sam's Pants").

I found Mr. Hoge in reminiscent mood, solaced by his big cigar. He told me many stories of early days, of the staff and of those who had come and gone during the last quarter century. At last came the "Logs" and I turned page after page of carefully entered records of nightly observations, noting the names of many famous men who were then engaged in research which has since met world acclaim. Here, among others, were recorded the observations of Dr. Harlow Shapley who joined the staff on April 26, 1914, and, there on the mountain top, examining and studying binary systems, variable stars, and globular clusters, laid the foundations for his remeasurement of the universe. He left to become Director of the Harvard Observatory, November 1, 1921.

There were two entries in the "Log" which Mr. Hoge gave me permission to copy. The first in particular is food for much romantic thought. It is dated November 2, 1917: "Clear. Alfred Noyes, English poet, visited with Dr. Hale. 100-inch telescope used for first time. Visual observations of star-clusters, Jupiter, moon and Saturn. Excellent results, especially on the moon. 15 for supper in the Galley."

This was shortly before Noyes published his "Watchers of the Skies."

For some years, beginning at about the time of the previous entry, Merritt C. Dowd was the electrician on the mountain. He was the father-in-law of Dr. Milton L. Humason. In those days it was evident that workers on the mountain kept certain pet animals, among which were several goats belonging to Mr. Dowd. One of these proved too great a temptation to a more ferocious species of native fauna, for Mr. Hoge has the following "note" in the "Log": "Sunday, January 19, 1919.

A mountain lion got Dowd's goat,
So Milton went a-hunting,
And now he has a lion skin
To wrap up Baby Bunting.

The lion was a mountain beast
More than a hundred weight,

From tip of nose to end of tail
She measured five foot eight.

Astronomers are very brave
To work up there all night,
With lions roaring all around
Most folks would faint with fright.

They're brave all right, but then we're sure
They'll all be glad to note,
No more will roam around the dome
The beast that got Dowd's goat."

So ended our first visit to the observatory on Santa Barbara street. Not until a fortnight later did I have the pleasure of meeting the Director, Dr. Walter S. Adams who was, at the time, ill at home. It was upon this second visit also that I met for the first time Dr. Humason, an actor in the zoological drama depicted above. We did not meet Dr. Charles E. St. John, famed for his work in solar physics, and also missed the pleasure of seeing again Dr. Seth Nicholson, who attained fame as the discoverer of Jupiter's ninth satellite. Because of their active interest in radiation, Dr. Nicholson and Dr. Pettit are known to the staff as the "Thermo-couple." During our visit Dr. Nicholson was quarantined in his home because of the illness of his son.

With the Mt. Wilson Observatory and the California Institute of Technology, Pasadena offers a third major attraction: The famous Huntington Library and Art Gallery. There my wife and I went after lunch. The beautiful park in which are set the two buildings containing their unique treasures is itself worth the visit many times over. The place abounds in ancient trees, flowering borders, and sunken Japanese gardens. Upon terraces among statuary and blossoming arbors, one has distant views of the country side across a long sloping terrain. It was a disappointment to learn that the Curator of the Library, Dr. Max Farrand, was out of town for the day. He and I had been school-mates back in New Jersey in the long ago, at the Newark Academy, when his father, Dr. Samuel A. Farrand, was its Head Master. How I should have liked to see him and to talk over those days. In the Library we saw the Gutenburg Bible, the ancient maps and letters of famous men. In the Gallery were The Blue Boy and Pinkie and the Mrs. Siddons of Gainsborough, and the exquisite Houdin busts. We called at the Atheneum Club later in the afternoon to get Dr. Merrill, who had arranged to take us to see Dr. Hale's private observatory, after which we were to dine with him at the Club. We drove around the great rectangle on which the new buildings of "Cal Tech" have been erected, and in one corner of which is the Club House. The grounds still resembled ploughed fields, graded but unsmoothed. Two long rows of poplars had been planted bordering what is to be the drive from the entrance gates to the main building. From the Club it is but a few blocks to Dr. Hale's sanctum and once there we left our car on the wide gravel road

within the high hedge surrounding the observatory and its trim garden.

We were admiring the flowers when Miss Louise Gianetti, Dr. Hale's secretary, appeared, soon followed by Dr. Hale himself, who gave us a hearty welcome. Dr. Hale though short and slender is straight and four-square of stature, with sparse gray hair and high, prominent forehead. His expressive features lent emphasis to his enthusiasm as he proceeded to tell us of this favored haunt of his where he spends so

FIGURE 3.
DR. HALE'S PRIVATE OBSERVATORY.

much of his time in work and play. Above the entrance door of the observatory the stone is carved in outline to represent the sun. At the end of each descending ray a tiny hand grasps a symbol. These symbols represent Life, Eternity, etc.

Dr. Hale, an ardent Egyptologist, took delight in explaining the source and significance of the design. He told us of the religion founded by the mother-in-law of Tutankhamen, based upon the power of the sun. He was much intrigued by this cult and had made a study of it. He had been in Luxor, on one of his many visits to Egypt, when the tomb of Tutankhamen was opened. The library of his observatory boasted a polychrome portrait bust of the mystic lady who founded the above mentioned order. The bust is a replica of the original found in

Egypt and now reposing in Berlin. Dr. Hale told us of his love of travel and said that in earlier days he had wandered much about the world. We gladly accepted his invitation to inspect his observatory, and found it the perfectly ordered affair that we knew he would demand.

FIGURE 4.
DR. GEORGE ELLERY HALE, FOUNDER OF THE MT. WILSON OBSERVATORY.

From the right of the entrance hall, through which rises the pier supporting the coelostat, the stairs wound up to the dome or down to the basement. At the left was the office of his secretary. Books everywhere lined the high wall spaces. A wide door opened into Dr. Hale's combined office and library. His desk was placed at an angle at the right just inside the door, and on the wide book-shelf at the left stood the bust of that ancient prototype of Mrs. Eddy. This was flanked by two bronze figures. On the opposite wall, in low relief and self tone, was a

design depicting the husband of the ancient queen, driving a chariot. Dr. Hale told of his endeavor to arrange these symbols and replicas to their best advantage. The easy chairs and convenient tables would suggest that Dr. Hale spends what time can be taken from his major hobby in dreaming of his loved Egyptian trophies. His chief interest, of course, lies in the further development of his spectrohelioscope. We were introduced to Mr. R. L. Hitchcock, the expert mechanician and operator who assists Dr. Hale in his endeavors to improve and simplify his devices for solar observation. We all went below stairs where the entire basement is devoted to solar instruments. There Dr. Hale, with almost boyish enthusiasm, showed us solar prominences and sun-spots, the latter reduced to spectral lines that changed breadth as we watched them. The changes were proportional to the amount of magnetic energy in the local field. The spots are polarized in opposition to this magnetic force. Thus magnetic fields are often found where no sun-spot exists, but because of the evidence of this force it can be predicted that one or more will there develop.

By this means meteorological disturbances may be forecast before the spots have even come into being. We saw instruments with which one is able to spectrograph and visually observe the sun at the same time. Not long before our visit Dr. Hale had completed the simplest of all spectroheliographs, intended as a model for the construction of these instruments by young amateurs. A description of this he was then preparing for the *Scientific American*. This instrument is contained in a box about two feet deep by one foot broad and two inches high, pivoted at one end and moving freely on ball-bearings at the other. The light from a simple coelostat enters at one side of the movable end and is admitted to the plate-holder through a nearby aperture in the same end. One movement of the box across the sun's image produces upon the plate a monochromatic picture of the sun. Dr. Hale showed us remarkably good spectroheliograms taken with this instrument, made with the light of calcium.

Again in the cosy library above we talked of mutual friends and of distant places we had visited. Dr. Hale loves to travel and seeks Egypt as a place of rest and relaxation. Here this eminent and busy man, the founder of a great observatory, showed us letters from young and unknown dreamers who are inspired by his patient encouragement and advice. As we were leaving for the Club, Dr. Merrill greeted a young man on the other side of the street. He crossed to our car, and we were introduced to Dr. I. S. Bowen, assistant to Dr. Millikan. It was Dr. Bowen who some few years ago solved one of the riddles of the universe by discovering the constitution of nebulium, that once mysterious substance composing the gaseous nebulae. I asked him, jokingly, if he was preparing to solve the problem of coronium, and was startled when he answered rather seriously, that he had been working on it for some time. At the Atheneum Club were Dr. and Mrs. Joy and our old

friend Professor Duncan of Wellesley, who were to dine with us. The large dining room was warm in its appointments. On the wall hung a life-sized group portrait of Dr. Hale, Dr. Millikan, and Alfred Noyes.

It was a good dinner, spiced with talk of stars and atoms, though my wife no doubt welcomed the presence of the ladies with whom she could discuss more human topics. Later in the evening there was to be a talk at the Club by Dr. Mars Baumgardt, son of the well-known lecturer on astronomy, and as Dr. Joy was to introduce the speaker, he had to leave us for a while. We had been entertained by Dr. Baumgardt in Los Angeles and were much impressed by the kindness of this big, cordial chap.

Dr. Baumgardt is an optician, in addition to being an ardent and enthusiastic astronomer. He directs the private observatory of Mr. Clark, son of the late senator from Montana, where among numerous other instruments, there is a 6-inch refractor. Dr. Baumgardt had taken us to see the observatory one evening, after a dinner at his club, and we had met again later at the opening of a new club-house for the Amateur Telescope Makers of Los Angeles. Here I had done what I could to impress the members with the value of variable star observation for amateur astronomers.

I am sorry that I haven't space to repeat some of the stories that Dr. Baumgardt told us concerning the progress of astronomy in the west. If it had not been that we were with other friends and were planning to be away upon our motor trip early next morning, we should have attended his lecture. Dr. Joy joined us in the lounge upon his return where we talked of things more tangible than stellar velocities.

The Joys told us of their children, a girl of nine and a boy of five. The Merrills have a youngster of six, an active young fellow whom we had seen earlier in the day playing in front of their home. Professor Duncan told of his numerous trips across country, often by motor and accompanied by his family, in order to carry on some special research at Mt. Wilson of which he was to tell me more later.

What a happy climax this had been to our first Pasadena visit!

During our meeting with Dr. Pease upon Mt. Wilson, he had invited us to call at Santa Ana and see the plant wherein he was carrying on those further experiments instituted by the late Professor Albert Michelson, in measuring the speed of light. This work Dr. Pease had undertaken at the time of Professor Michelson's last illness. We had begun our tour of Southern California, and from Pasadena proceeded southward and seaward, reaching Santa Ana at mid-morning. A mile or so beyond the city, upon a desolate, flat stretch of roadway, we saw ahead and to our left a small group of rough shacks, from which extended in a straight, horizontal line a huge pipe, close to the ground. It looked like the main artery of a pipe-line system. It was the mile-long tube, back and forth through the length of which light is sent, that its speed may be measured. Leaving the car and climbing over the broken earth of the fields, we approached the first of the shacks and were delighted

when Dr. Pease, rough clad but jovial as ever, came out to greet us. With him was Mr. F. Pearson of the University of Chicago, assistant to Professor Michelson. He is the quiet, pleasant young man who has been closely identified with this enterprise. They described to us the difficulty of finding a piece of land containing a mile long level stretch. I climbed to the roof of a shack to get a perspective picture of the tube, which was three feet in diameter and built of corrugated iron in 60 foot sections. These sections are cemented together with rubber, both to

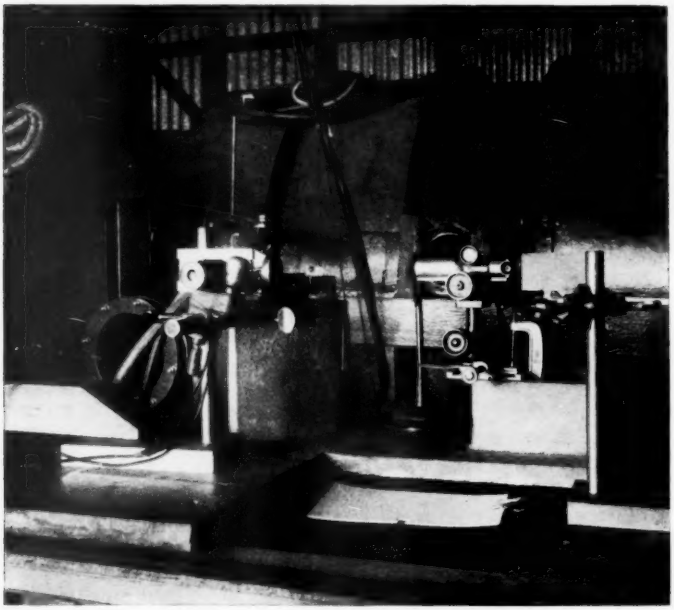


FIGURE 5.
MECHANISM EMPLOYED IN MEASURING THE SPEED OF LIGHT.
SANTA ANA, CALIFORNIA.

overcome expansion and to insure sufficient tightness of the joints to permit exhaustion of the air. Air was pumped out at the middle of the tube until only one-eighth of one per cent was left. Despite this it was necessary that the experiments be made at night to avoid the slightest chance of the light beam being affected by temperature. The length of the tube had been determined to within one millimeter and could be adjusted to correct even this slight difference.

We were taken into the room containing the mechanism employed in the process of measuring the light speed. The shack was built over and around the end of the tube whose size was exaggerated in the small en-

closure. A system of mirrors within the tube reflects a beam of light ten times its length, and this beam then emerges to fall upon a small, horizontal wheel having 32 facets. By air power the wheel is made to revolve 580 times per second. A tuning-fork, whose tone would respond only to the vibration set up by the wheel at that speed, was the means of control. Through a small telescope the facets are watched during the timing. Succeeding steps in the process were rather too intricate and exacting for my comprehension. There were corrections to be applied and a discouraging array of compensating adjustments in both time and distance measurements. Though no very exact results from these experiments had been determined before we left the state, I have since learned that each attempt of the kind results in a slightly shorter distance for the course which light covers in its one second sprint. It is difficult to believe, however, that this athlete of the cosmos is slowing up. After a short visit we left our friends to their lonesome but interesting occupation. Within an hour or so we had reached the Pacific and trailing the shore, over perfect highways, found ourselves before nightfall, not far from the Mexican border.

East Orange, New Jersey, January 20, 1933.

The Sun's Heat

By EDWARD GODFREY

One of the great puzzles of science is an explanation of the origin and the continued enormous output of the heat of the sun. The theories that have been advanced to solve the problem are the following.

The coming together out of a nebulous state of the matter that composes the sun, under the influence of gravity of the mass as a whole, would tend to bring that mass of matter to one locality, namely, the center of mass of the whole. Impinging and pressure, resulting from this motion and the arresting of the same, would produce heat. There can be no question that this would result in the creation of great heat. Proof of this method of generating heat can be exemplified on the earth. But this heat would soon radiate into space.

The continued emission of heat from the sun, with apparent undiminished intensity for many centuries, does not admit of so ready an explanation.

One theory, scarcely ever referred to now, accounts for this heat supply by the supposition that meteoric matter is continually falling into the sun from space and creating heat by its impact. This theory is not tenable. It would mean an enormous amount of matter streaming daily into the sun. If this were the case, the earth would receive a share of this fugitive matter instead of an occasional particle, a so-called shooting star. Even these meteorites do not bear evidence that they are aimed at the sun but rather that they are in comet paths.

Shrinkage of the sun has been set up as a theory to account for the heat. The theory is that under the force of gravity of the sun for its own mass the pressure generated gradually reduces the diameter, and the heat of this compressive action is radiated from the sun. The earth does not afford any analogy to substantiate this theory. It is true that terrestrial gases, for example, will give off heat while they are being compressed and for a short time after the pressure is applied, reaching equilibrium when the surrounding temperature is reached; but the continued application of the same pressure has no influence in causing the radiation of more heat. No matter how great the pressure in a confining vessel, there is just so much heat generated at the time of the application of that pressure, and this heat is quickly dissipated leaving the compressed gas at the temperature of surrounding objects.

The most recent theory set up to account for the sun's supply of heat is atomic power. This theory asserts that matter is undergoing change, giving off energy in the process. Matter that is commonly supposed to be inert and stable is said to be capable of giving off enormous quantities of heat in transformations that are said to be going on in the sun.

Here too, there is no terrestrial analogy. Any transformation of matter that can be brought about on the earth, causing it to emit ions or electrons, is only accomplished by the expenditure of energy in far greater amount than that which is produced by the process.

It is on the order of speculation and unconfirmed hypothesis to assume properties of matter in the sun that are not shown to exist in the case of matter in the earth.

I believe no other theory has been proposed as a solution of the problem, unless it be the assumption of the existence of radioactive matter in the sun. The emanations from such matter are quite different from the light and heat received from the sun, and it is not logical to assert that such matter would be confined to the deep interior of the sun. There is every evidence that the sun is a seething caldron, spouting incandescent matter out into space for hundreds of thousands of miles.

There are several facts concerning the heat of the sun that the foregoing theories do not attempt to account for.

One fact is the near approach to constancy of the amount of heat received by the earth. What safety valve is acting, if the "compression" theory is true, to keep the sun from attaining a far greater heat or to prevent it from cooling down materially? If the "atomic power" theory is correct, what regulates its action to such nicety? The same can be said of the radioactive-matter theory.

Another cogent fact is that the sun's heat varies several per cent above and below a practically constant average, at least the heat received by the earth has this remarkable balance and equally remarkable variation.

The theories named have no explanation for this variation, which, if it should not be arrested, would mean untold ruin and death on the

earth by excessive heat or cold.

A theory that meets all of the objections that stand against the other theories and at the same time accounts for both the continued general average of heat output and the variation in that output is set forth in the following.

All of the laws on which this theory is based are known and codified laws of mechanics. They are all manifested and demonstrable on the earth. These laws are the following:

1. *Gravitation.* It is not here called acceleration. Acceleration means the quickening of speed. Gravitation on a heavenly body (of circular orbit) could act for ages without the slightest quickening of speed. It can act on a body (lying on the earth's surface) and produce no velocity whatever in any length of time. Gravitation is the urge of one body toward another. The intensity is directly as the product of the masses and inversely as the square of the distance between the bodies.

2. *Centrifugal Force.* This is the outward urge of a body compelled by any means to travel in a curved path. The intensity of the urge, away from the center of curvature of the path, is directly as the mass of the body and directly as the radius of curvature, assuming any given constant angular speed. This is true of the body as a whole, and it is true of every particle of a body; those that are farther from the center of rotation have the greater urge from the center.

3. *Extension Under a Stress.* This includes flow of fluid substances. When any part of a body is subjected to a force that is not balanced by an equal force in the opposite direction, motion will be set up. In a fluid the part of the body subjected to the unbalanced force will flow in the direction of that force. In a solid body the force will be expended in producing stress and elongation. In steel, for example, every pound per square inch of stress will shorten or lengthen the piece (according as it is compression or tension that is applied) one-thirty-millionth of the original length. In other substances the change in length is greater.

4. *Frictional Heat,* or heat generated by friction, due to flow of fluids or internal strain in solids. The continual kneading of a nonelastic solid or of a plastic body and the continual stirring of a fluid one will generate heat in such bodies.

Based on these well-known laws of physics or mechanics, applying them to the solar system, an explanation for the origin and continued supply of the sun's heat is found.

To anticipate the theory, these startling things stand out.

The sun's heat is due primarily and almost solely to the presence of the giant planet Jupiter in our system.

Without that planet in the system the sun would emit so little heat that all life on our planet would soon become extinct. Jupiter is not only the source of the continued supply of heat from the sun, but is

also the one stabilizing influence that is responsible for the constant general average of that heat output.

The other planets, particularly those nearer to the sun than Jupiter, add their quota to the sun's heat by amounts that are gaged by the relative positions of those planets and Jupiter and the sun.

The other planets account for the rise and fall of the sun's heat output. As stokers they each add their quota, so to speak, to the sun's fire; and when that quota is dissipated by radiation, another contribution is awaited, either from that planet's influence or from that of another.

The earth, as one of the major stokers, contributes vastly more heat to the sun than it receives from that body.

Because of the great mass of Jupiter as compared with the other planets the sun itself is swung around in an approximate circle of comparatively short radius, the center of the circle being the common center of gravity of sun and planet. The center of this circle is not far from the surface of the sun. It requires 11.9 years for the sun to negotiate this path, and yet the computed centrifugal force of the great mass of the sun pulling away from the center of curvature of its path would snap a wire of the strongest steel, if that wire were 8500 miles in diameter. Or to put it another way, if a steel rod were designed to support the weight of Jupiter away from the sun, at 16,000 pounds per square inch, the safe load allowed on bridge members, the rod would have to be 40,000 miles in diameter.

The gravitation of Jupiter overcomes this gigantic force as a whole, but gravitation and centrifugal force do not balance one another when considered in detail. On a unit mass on the side of the sun toward Jupiter the gravitation toward Jupiter is great, but because of the short distance from that same unit of mass to the center of the revolution of the sun the centrifugal force is comparatively small. There is therefore an unbalanced force tending to cause the substance of the sun to rise toward Jupiter on that side of the sun.

On the other side of the sun the condition is just the reverse. The centrifugal force of a unit of matter, due to the sun's revolution around center of gravity of sun and planet, is greatly in excess of the gravitation toward Jupiter acting on the same unit of mass. This can be found by computation to be true. The result is that matter on that side of the sun will also tend to rise from the surface of the sun.

The effect of these unbalanced forces on the sun is to elongate the diameter of the sun in the direction of the radius vector of Jupiter. This is in accordance with the third law stated at the beginning of this article. Whether the sun is solid or fluid, the laws of mechanics and physics would dictate this elongation.

Accurate observation of the sun's limb is difficult, because of the turbulence of its surface. I know of no measurements that prove or disprove this elongation. It is true, however, that observations on transits of Venus have given puzzling and seemingly discordant results. This

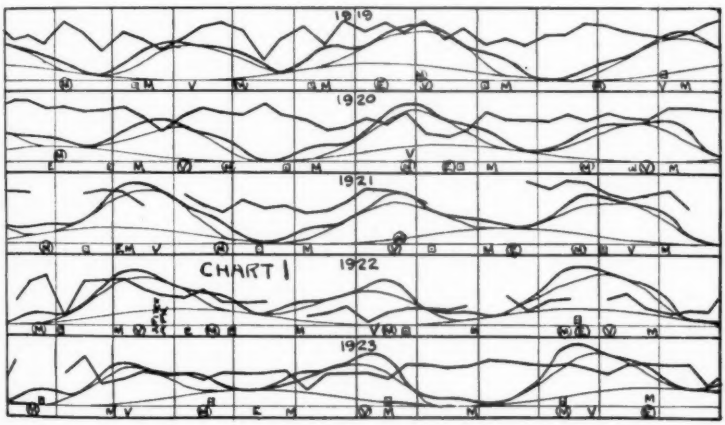
is doubtless due to the difference in the equatorial diameter of the sun as seen when Jupiter is in quadrature and in opposition or conjunction.

Because the sun is rotating once in about 25 days the elongated diameter is continually shifting. In other words the influence of the sun's great satellite is to stir up and knead the body of the sun keeping its substance in great turmoil. This action generates heat and sustains the high temperature of the sun.

The path of Jupiter has an eccentricity of only about .05. The regularity of its motion is therefore responsible for the sustained general average of the sun's heat.

Mercury, Venus, and Earth are the stoker planets. These are responsible for the increase in heat over the nearly constant value sustained by Jupiter. These planets are of too small mass to affect the sun materially by swinging it in its course, but they have a gravitational force on the protuberances of the sun produced by Jupiter's influence.

When any of these planets is in line with Jupiter and the sun, the unit force of gravitation on the near protuberance is greater than on the main body of the sun; this accentuates the lifting force increasing the depth of that protuberance. On the far side of the sun the reverse is true; this increases the depth of that protuberance. Thus the kneading influence is greater when Mercury, Venus, or Earth are lined up with Jupiter, and consequently the heat of the sun is augmented.

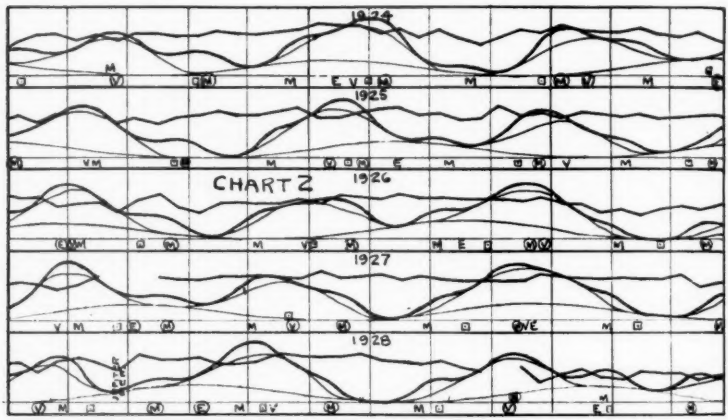


Variation of the sun's heat output has been accurately measured by an instrument designed by Dr. C. G. Abbot, of the Smithsonian Institution, and a record has been kept for some years. In more than 10 years the solar constant has varied between 1.904 and 1.969, a variation somewhat greater than 3 per cent. These values are charted for 1919 to 1928 inclusive on Charts 1 and 2. The average solar constants for 10-

day periods are indicated, and these are joined by the zigzag lines. Some values are missing in the record.

On the same charts I have shown the times when Mercury, Venus, and Earth are in line with Jupiter and the sun. The letter M indicates when Mercury is in the same longitude as Jupiter: the same letter in a circle indicates when that planet is opposite the sun. In locating these points Mercury's velocity was assumed to be constant, so that some locations will be a little inaccurate. In the same manner the positions of Venus with respect to Jupiter are indicated by the letter V and those of the earth by the letter E. A square with a dot in the center indicates when Mercury is in perihelion.

The product of the mass and the inverse square of the distance to near and far surface of the sun is taken as the index of the kneading effect of the several planets. These coefficients are as 29, 9, 47, and 22 for



Mercury in perihelion, Mercury in aphelion, Venus and Earth respectively.

The curve shown on the charts is constructed by interposing sinusoids, one above the other having their high points at the time of the lineup with Jupiter. The final curve representing the combined heating influence of the three planets is the upper curve.

For several reasons a close agreement between these curves, one representing the sun's heat intensity and the other representing its cause, is not to be expected. A cause for added heat may be deep-seated, and its effect may not be manifest at once. One way to cool off a coke fire, temporarily, is to shovel in a lot of coke; but the after effect is greater heat. The portion of the sun where the extra heat is generated may not be on the side where the earth happens to be, and by the time this side is rotated toward the earth much of the heat may be dissipated. The sun has great capacity for the storage of heat.

Added heat produced by Mercury would probably be superficial and exhibit quick response. There are a large number of places in these charts where the rise in the curve due to Mercury corresponds to sharp rises in the solar constant.

Venus and Earth give rise to more deep-seated influence: there is slower response, and the heating influence is more lasting.

Another influence contributing to irregularity is clouds in the vicinity of the sun. At times when the disturbing forces of Venus and Earth are united and particularly great, there are upheavals, volcanoes due to gas pressure beneath the surface of the sun. These are the sun spots that we see. Vast quantities of matter, many times the mass of the earth, are thrown out into space a million miles or more. This cloud of matter absorbs some of the sun's heat. This influence has been observed in measurements of the solar constant, for while the heat at times of many sun spots is generally greater, there has been found to be a temporary drop when a great sun spot crosses the sun's disc.

These clouds would also serve to blanket the sun's heat and hold back its radiation. This influence would tend to even up some of the high and low values that might be expected in the charts of the solar constants.

The general low values for the solar constant in 1922 are accounted for by the fact that Jupiter was in aphelion in March of that year. This cooling influence can be traced for more than a year. In temperature records there is a three year drop beginning with a peak in 1921. This illustrates the storage capacity of the earth itself, as well as the fact that response lags behind the cause in heat increase or decrease.

This is an augury of what would happen to the only possible inhabitable paradise of the solar system, the earth, if Jupiter should be removed. A short period only would be required for a complete freeze-up.

We can probably attribute our occasional cold summers to Jupiter's aphelion journey. The short hot spells are probably the work of the active little planet Mercury.

It is to be noted that the earth's atmospheric temperature and the heat emitted by the sun may not show agreement. Greater heat received in the torrid zones will cause increased convection, which in turn may cause increased flow of cold air from the polar regions, cooling off the earth's atmosphere.

Charts 1 and 2 show in general that the planets Mercury, Venus, and Earth accelerate the sun's heat about three times a year. The solar constant curve shows roughly this same triple wave. Time required for radiation of the stored heat affords an explanation of the comparative flatness of the "solar constant" curve.

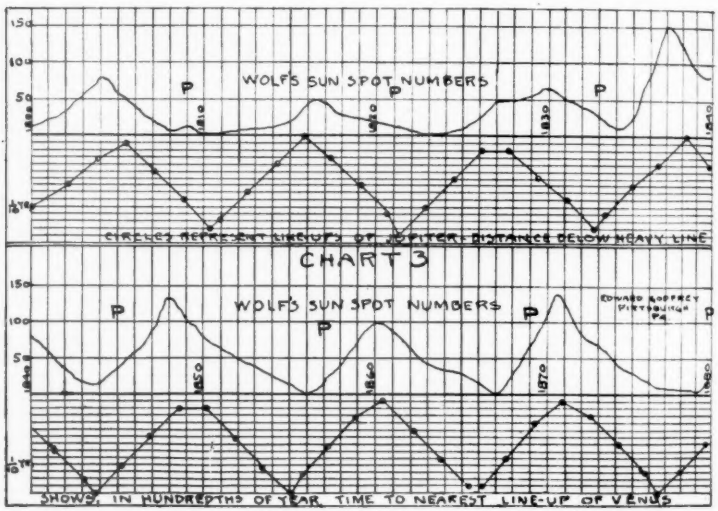
Dr. C. G. Abbot in a letter to me states that the original solar radiation graph reveals certain periodicities, notably 11, 15, and 25 months and eleven years, besides numerous others. In this connection, bearing in mind that exactness is not to be expected, the figures of the following

paragraph are significant.

The average period between conjunction and opposition (as viewed from the sun) of Mercury and Jupiter is .1229 years, and the corresponding period for Venus and Jupiter is .3244 years.

3 Venus periods	.9732
8 Mercury periods	.9832
4 Venus periods	1.2976
10 Mercury periods	1.2290
7 Venus periods	2.2708
18 Mercury periods	2.2122
34 Venus periods	11.0296
90 Mercury periods	11.0610

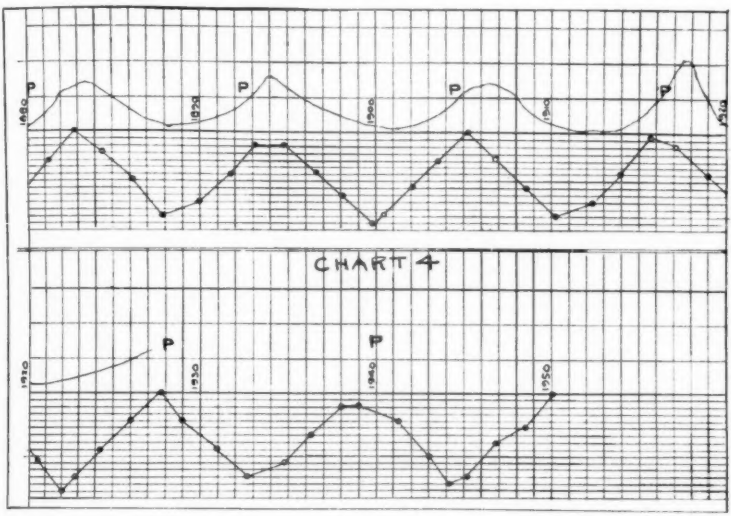
In addition, the earth's own period is commensurate with the 11 year period in the above. These are not far from the periodicities mentioned by Dr. Abbot, and numerous other commensurate intervals appear in the comparison that would probably account for the others.


WOLF'S SUN SPOT NUMBERS
CIRCLES ABOVE SHOW DIP OF JUPITER'S DISTANCE BELOW MEAN LINE
CHART 3
WOLF'S SUN SPOT NUMBERS
SHOWS, IN HUNDREDTHS OF YEAR, TIME TO NEAREST LINE-UP OF VENUS

Charts 3 and 4 supplement the other charts and confirm them. These charts have to do with the sun spots. They are worked out on a somewhat different plan, but are based on the same laws of mechanics and physics. It is well known that times of high sun spot counts are times of relatively high heat in the sun. If then those times of high sun spot counts can be identified with periods when the heat intensifying influences are most active, as predicated in this theory, there is strong reason to conclude that the theory is the correct explanation of the cause both of the origin and of the continued supply of the sun's heat.

The conjunctions and oppositions of Jupiter are taken as a basis. These are times when extra heat is generated in the sun. If Venus

should be in conjunction at or near the same time, the influence of that planet in heating up the sun is added to that of the earth. These charts show by ordinates, in hundredths of a year, the time intervals between the nearest lineups of the three planets, Jupiter, Venus, and the earth. These time-intervals by their shortness will be an index of the accelerated heat of the sun and consequently of sun spot counts, assuming that sun spots are caused by that acceleration.



Remarkable agreement over a period of more than 100 years is indicated. And this is not all. The agreement holds for 300 years, the entire time in which sun spots have been observed and counted. The average interval between high counts in that period is 11.2 years, and 22.38 years is almost exactly 41 of Jupiter's half synodic periods as well as 28 of those of Venus. In other words the lower locus of charts 3 and 4 will be repeated for many hundreds of years.

As explained in connection with charts 1 and 2 exact mathematical agreement is not to be expected. Sun-spot counts are not an exact index of the sun's temperature, only a general one. Astronomers have recognized an underlying cause making for 11.2 years as the average sun-spot period with some other cause tending to show irregularities. The underlying cause is the lineup of Venus and the earth with the sun, the causes producing irregularities are Mercury's influence and possibly Jupiter's approach to perihelion and aphelion. Several of the high count peaks appear to be low or displaced because Jupiter was in aphelion at the time when peaks would be expected to occur, 1815 and 1827 for example.

Chart 4 is extended insofar as the "cause" curve is concerned, to 1950. Peaks in sun-spot counts may be expected about 1939 and about 1951. The letters P in the charts indicate Jupiter's perihelion position. When these are near peaks in the "Cause" curve, the periods of high spot counts seem to be stabilized.

If critics of this theory should demand precise agreement as a basis of its acceptance, let these facts be remembered.

1. The bodies dealt with are gigantic.
2. Such bodies require time to respond to any reaction.
3. The heating influence is not a sudden but a gradual thing.
4. Jupiter may be close to its perihelion distance for years though not exactly at perihelion.
5. The action is purely physical. No electrical influence whatever is predicated. In fact I do not believe any electrical influence can be exchanged between bodies so far apart as planets. Electrical manifestations on the earth during sun activity are generated in the earth itself on account of extra heat received.

It will be asked: Whence the energy? and What about the law of conservation of energy? The source of the energy is the infinite source of the moving impinging ether, moving at the speed of light, the source of all energy. The alleged law of conservation of energy is a good rule to curb seekers after perpetual motion, the multiplication of power by ordinary means. Patentees cannot duplicate the sun-Jupiter engine, but they may some day capture this fugitive energy by some other means.

The Cincinnati Observatory Eclipse Expedition August 31, 1932

By ELLIOTT SMITH

The Cincinnati Observatory party made observations of the eclipse from North Stratford, New Hampshire. The eclipse camp chosen was an excellent site for the purpose in hand. The Connecticut River was in the foreground, and the rugged country beyond terminated in a pleasing skyline of Vermont Mountains. The high elevation of the camp just outside the town insured freedom from traffic and other interference.

One good fortune attendant upon this choice of site was that our nearest neighbor, Mr. Niel Farnsworth, placed at our disposal his well-equipped tool shop without restriction. The only occasion on which he seemed seriously to question the wisdom of his generous offer was when he discovered that the astronomer had appropriated a full bottle of non-denatured alcohol for cleaning his instrument, when the other

kind was at hand in abundance. It should be made clear at this point that, as expert in charge of the village lighting system, he had a technical use for the more refined product. The observers from Cincinnati make grateful acknowledgement, withal, for his hospitality and assistance.

The instrument used on this expedition was a Cooke lens of 68 inches focal length, diaphragmed to an aperture of 6½ inches. A k-2 color filter and Special Eastman plates were used with this instrument.

The Observatory's Cooke lens was supplemented by a Zeiss telescope of shorter focus and smaller aperture, obtained through the good offices of Dr. Frank Kessler from Captain Stevens of the Wright flying field, Dayton, Ohio. It was proposed to supplement the photographs taken with the Cooke lens, employing color screen and special plates, with those simultaneously taken with the Zeiss lens without a color screen and using with it orthochromatic plates. The cradle type mounting of the polar axis for these telescopes was constructed at the plant of the LeBlond Machine Tool Co. near the Cincinnati Observatory. Willard Groene of the LeBlond plant gave practical attention to the construction and mounting of the instrument and was helpful at all times with advice as well.

Dr. Yowell, Director of the Cincinnati Observatory, was in charge of the party, and was accompanied by the author, as co-worker. We arrived at the eclipse site three weeks before the date of the eclipse, where we were joined by Mr. Herget of the Observatory staff ten days before the event. Mrs. Yowell, Mrs. Smith, and Miss Harriet Smith were members of the party, and were ever ready to offer a helping hand as preparations for the eclipse proceeded.

During the days of preparation greetings were exchanged with astronomers and scientists who visited the different sites along the path of the eclipse, and opportunity was taken by the Cincinnati party to see the equipment of other eclipse camps. At all the sites visited, although preparations were going forward in a vigorous manner there was an attitude of anxiety, lest at the last moment some item essential to the success of the observations should be found to have been overlooked.

The inexorableness of the coming event is always in mind. In the ordinary course of observatory work observations may be repeated, but not so here. After a certain second on a given day no remedy for items overlooked can be found. Add to this the shortness of duration, the 50-50 probability of cloudy weather, rendering all the careful preparations of no avail, and the elements are present to try the nerves of those who journey far to make scientific observations of eclipses. An astronomer in charge of one of the parties visited declared that this would be his last eclipse as a scientific observer. He expressed the hope, however, that he might one day have the opportunity of being encamped on another eclipse path as a mere spectator at the proper time, and really see and enjoy an eclipse.

The geographical position of our instrument was accurately determined from a bench mark of the Coast and Geodetic Survey back a few hundred feet from our camp. The exact time was obtained by radio and by wire through the courtesy of the local telegraph operator.

Professor W. E. Anderson of Miami University, on the invitation of Dr. Yowell, was with our party to count the one hundred seconds of

FIGURE 1.

totality and to give the time at such intervals as our observations of the partial phases required. It was an arduous assignment under the conditions of an alternately appearing and disappearing sun in clouds, and the Cincinnati observers wish to record here their appreciation of his work.

The state of cloudiness at the time of the eclipse is well depicted in the accompanying photograph (Fig. 1) taken by Miss Smith four minutes before totality. The telescope in the foreground is pointed to the

bright spot in the clouds where the crescent sun is becoming more slender in its progress toward totality. To the west above the Vermont hills, across which the eclipse shadow would speed toward us in a cloudless sky, are low overhanging clouds. During the partial phases, both before and after totality, there was no time at which the sun could not be looked at with the naked eye, and only at intervals during these phases was it visible. Near the end of totality, however, the clouds thinned out so that through a small telescope or binoculars red prominences could be seen aroud the limb of the eclipsed sun. It was at this period that a longer exposure than had been planned was made with both cameras.

Of the two, the photograph (Fig. 2) taken with the Cooke lens was the only one from which a print could be made. The accompanying photograph is the result of our endeavor. The condensations about the limb indicate the positions of the prominences with their light diffused

FIGURE 2.

by intervening clouds. Although we were not favored with a cloudless sky the photograph, nevertheless, makes record of the fact that the Cincinnati Observatory was represented on the eclipse path and obtained a photographic record of the eclipsed sun, shorn though it was of its corona by clouds.

If the enthusiasm of eclipse observers is modified by a feeling of too great responsibility for the result of their undertaking it is interesting, on the other hand, to have the point of view of a care-free observer intent on witnessing a rare event in nature. A Cincinnati viewer of the eclipse near our camp wrote the following as his own private record of the event:

"I saw it first through the clouds, an indescribably beautiful thing, with lovely, tenuous prominences of transparent red. I forgot time, forgot about the one hundred seconds; I wanted to keep on looking. Then without warning, so sudden as to be breath-taking, a tiny bead of sunlight appeared between the mountains of the moon. To me it was a tumultuous experience. I did not see the stars come out, I did not see the chickens go to roost, but for a few momentous seconds I glimpsed a realm beyond."

Addendum to Paper on the Size of Meteors, and the Leonids of 1932*

It is possible that the views there expressed on the size of meteors, if correct, may somewhat modify our belief in the very high temperature of the upper layers of our atmosphere suggested by Messrs. Lindemann and Dobson, which have always seemed improbable to some people. On page 23 there are three errata. In line 15 for 0.35 read 0.47. In the next line for 1/100 read 1/75. In line 25 for 1/25,000 read 1/20,000.

On page 24 we refer to the fact that the spectra of three meteors give no evidence of the presence of iron lines, but mainly of hydrogen, helium, and probably according to Moscow of calcium, magnesium, potassium, and in one meteor of thallium. This would seem to imply that iron cannot retain its characteristic composition at these high temperatures, but is broken up into hydrogen, helium, and perhaps some of the lighter metals, which can withstand them. Similarly we know that molecules are broken up into their component atoms as the temperature rises. This of course is the reverse case of the well known fact that the heavy metals are not found in the atmospheres of the hotter stars, and apparently do not form until lower temperatures are reached, their mere presence giving us a test of the temperature.

It appears to me that Table II on page 29 gives the observed data in a convenient form. On re-examining it, I believe I should introduce a column following that headed E.S.T. giving the duration of each period of observation. I should also place the column headed Leonids ahead of that headed Outside. W. H. P.

MANDEVILLE, JAMAICA, B. W. I., JANUARY 24, 1933.

*A paper published in POPULAR ASTRONOMY, p. 22, January, 1933.

Planet Notes for April, 1933

By CLIFFORD E. SMITH

The *Sun* will be moving northeast from the central part of Pisces to the central part of Aries. Its distance from the earth at the beginning of the month will be about 92.8 million miles and this distance will increase about 0.7 million miles during the month. The position of the sun on the first and last days of the month will be, respectively: R.A. $0^h\ 40^m$, Decl. $+4°\ 17'$; R.A. $2^h\ 27^m$, Decl. $+14°\ 34'$.

The phenomena of the *Moon* will occur as follows:

First Quarter	April	2	at 12 P.M.	C.S.T.
Full Moon		10	" 8 A.M.	"
Last Quarter		16	" 10 P.M.	"
New Moon		24	" 1 P.M.	"
Perigee		12	" 5 A.M.	"
Apogee		27	" 10 P.M.	"

Mercury will be in southern Pisces during April, and its apparent motion among the stars, except for the first three days of the month, will be easterly. Its distance from the earth at the beginning of the month will be about 55 million miles and this distance will increase about 38 million miles during the month. The

corresponding change in apparent diameter will be from about 11 to about 7 seconds of arc. On April 20 Mercury will be at greatest elongation west (27° 25′), and thus, during that part of the month, it will rise about 1¾ hours before the sun. Conjunction with the moon will occur on April 22 at 7h 47m A.M., C.S.T. (Mercury 5¾° S).

Venus will be too near the sun in apparent position to be of interest during this perior. Superior conjunction with the sun will occur on April 21.

Mars will be in central Leo. Its apparent motion among the stars will be westerly until about the middle of the month, and thereafter easterly. At the beginning of the month its distance from the earth will be about 73 million miles and its apparent diameter will be about 12 seconds of arc, but, by the end of the month, its distance will have increased about 15 million miles and its apparent diameter will have decreased about 1½ seconds of arc. Mars will be in conjunction with the moon on April 6 at 9h 11m P.M., C.S.T. (Mars 2¾° N).

Jupiter will be in eastern Leo. During the middle of the month it will be on the meridian about 9h 30m P.M., Standard Time, and, during the middle of the month, its distance from the earth will be about 430 million miles and its apparent diameter will be about 40 seconds of arc. Conjunction with the moon will occur on April 7 at 9h 36m P.M., C.S.T. (Jupiter 2½° N).

Saturn will be moving with an apparent easterly motion in central Capricornus. During the middle of the month it will be on the meridian about 7h 30m A.M., Standard Time, and, at that time, its distance from the earth will be about 930 million miles and its apparent diameter will be about 15 seconds of arc. It will be in conjunction with the moon on April 18 at 6h 18m A.M., C.S.T. (Saturn 1¼° N).

Uranus will be in conjunction with the sun on April 13, and will be too near the sun in apparent position for observation.

Neptune will be in Leo about half way between Mars and Jupiter, and its apparent motion will be retrograde. Its distance from the earth will be about 2.7 billion miles, and its apparent diameter will be about 2½ seconds of arc. Conjunction with the moon will occur on April 7 at 8h 18m A.M., C.S.T. (Neptune 1° N).

Variable Stars

Monthly Report of the American Association of Variable Star Observers for January, 1933

In spite of the excessive amount of cloudy weather reported from nearly every section, the total number of observations listed here is a thousand more than for the corresponding month of 1932. The "Astronomisk Selskab" of Norway has contributed a lengthy list of observations of U Geminorum as made during 1932. These are not listed herewith but they add materially to the record of the activities of that star during the past year.

Word has just reached our headquarters of the death in October last of William A. Macpherson, late of Los Angeles, and for a number of years a Patron of the Association. Mr. Macpherson was particularly interested in celestial photography and a few years ago presented to the Association his photographic equipment.

For the tenth consecutive year the Association is indebted to Mr. J. H. Skaggs of Oakland, California, for his very useful Julian Day Calendar for 1933. Besides

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1933.

Nov. 0 = J.D. 2427012; Dec. 0 = J.D. 2427042; Jan. 0 = J.D. 2427073.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

V SCL
000339
020 10.0 Bl
034 10.3 Bl

S SCL
001032
020 6.3 Bl
029 7.3 Ht
034 7.2 Bl
039 7.5 En
039 7.6 Ht
060 8.4 Me
062 8.6 Pt

X AND
001046
059[12.9 Me
065 14.0 B

T CET
001620
060 5.7 L
068 5.9 L

T AND
001726
059[12.9 Me
065 13.5 B
068 13.5 El
088[11.8 Hi

T CAS
001755
042 11.7 Jo
047 11.4 Jo
059 11.1 Me
060 10.1 L
062 11.0 Pt
062 11.3 Jo
064 11.0 Jo
068 10.5 Jo
070 10.7 B
071 9.9 Jo
072 10.5 L
073 10.0 My
085 9.7 Sr
094 10.5 Sr
094 10.6 Sv

R AND
001838
042 12.5 Jo
059 10.7 Me
060 10.7 Ah
062 10.6 Pt
062 10.1 Ko
064 10.7 Jo
068 10.3 Jo
068 10.0 B
068 10.2 El
071 10.0 Jo
071 10.3 Ah
097 9.4 Sv

S TUC
001862
018 10.4 Ht
020 10.4 Bl
029 10.8 Ht
034 11.0 Bl
039 11.8 Ht

S CET
001909
030 11.3 Hi
043 12.0 Jo
047 12.5 Jo
059 12.6 Me
060 13.0 L
069 13.1 L

T PHE
002546
020 10.5 Bl
029 10.8 Ht
034 11.1 Bl
039 12.0 Ht

W SCL
002833
034 13.1 Bl

U CAS
004047a
060 13.6 L
072 13.6 L
088[13.3 Hi

RW AND
004132
062[12.6 Pt
072[11.0 Hi

V AND
004435
059 10.7 Me
060 10.0 L
068 10.4 B
072 10.9 L

X SCL
004435
020 10.5 Bl
034 11.0 Bl

RR AND
004533
059 10.3 Me
068 10.7 El

RV CAS
004746a
060 9.4 Me
062 9.8 Pt
065 9.4 B
078 10.3 B

— CAS
004746b
060 10.6 Me
062 11.1 Pt

W CAS
004958
042 10.5 Jo
047 10.7 Jo
047 10.8 Ko
060 10.5 Me
062 10.4 Ko
062 10.4 Jo
062 11.1 Pt
068 10.2 El
068 9.8 Jo
068 9.7 B
071 9.5 Jo
075 10.0 BL
078 9.9 BL
086 9.7 BL

U TUC
005475
014 11.3 Sl
018 11.5 Ht
020 11.5 Bl
028 12.5 En
029 12.1 Ht
034 12.9 Bl
037 13.2 Sl
039 12.7 Ht

Z CET
010102
043 8.9 Jo
056 9.0 Ko
060 9.2 L
060 8.8 Me
062 9.3 Pt
069 9.5 L
073 9.5 El

U SCL
010630
034[13.2 Bl

U AND
010940
060 10.2 L
060 10.5 Me
062 10.9 Gy
064 11.0 Gy
068 10.9 B
068 10.7 El
072 10.6 L

UZ AND
011041
060 13.7 L
068 13.3 El
072 14.2 L

S PSC
011208
060 12.2 L
072 12.5 L
073 12.9 El

S CAS
011272
060[12.5 Me
063[12.3 Bc

U PSC
011712
060 13.1 L
069 12.3 L
073 12.8 El

RZ PER
012350
048 9.4 L
060 9.7 Me
062 9.4 L
068 10.0 El
072 9.6 L

R PSC
012502
060 11.8 Ah
060 10.7 Me
062 11.9 Pt
062 11.7 Gy
063 11.8 Ah

RU AND
013238
060 10.7 L
062 11.0 Gy
062 11.0 Pt
063 10.7 Me
072 10.6 L

Y AND
013338
060 13.2 L
063 13.3 Me
072 13.9 L

X CAS
014958
042 9.3 Jo
045 10.7 Bn
047 9.5 Jo
062 10.5 Pt
063 11.1 Bn
064 10.7 Jo
067 10.8 Me
068 10.7 Jo
071 11.0 Jo
072 11.0 Bn
078 10.1 B

RR ARI
015023
058 5.8 Mc
059 5.8 Mc
060 6.0 Mc
061 6.0 Mc
062 5.7 Mc
065 6.0 Mc
069 5.8 Mc

U PER
015254
042 8.4 Jo
047 8.6 Jo
059 9.7 Ah
059 10.0 Ry
060 9.4 Mc
062 9.7 Pt
063 9.9 Ah
064 10.1 Ry
064 9.7 Jo
068 10.1 El
071 9.5 Jo
071 10.0 Ah
073 10.2 Ry
075 10.2 Cy
075 10.2 BL
078 10.0 BL
086 10.5 BL

S ARI
015912
060 10.8 L
067 10.4 Me
072 10.8 L

R ARI
021024
047 10.9 Jo
057 10.4 Jo
058 10.5 Ah
060 10.4 Ah
060 10.3 L
062 10.5 Pt
062 10.2 Jo
063 10.2 Ah
067 10.1 Me
068 9.8 Jo
069 10.0 L
071 10.0 Ah
071 9.9 Jo
072 9.8 Ah

W AND
021143a
042 12.3 Jo
047 12.5 Jo
062 12.8 Pt

T PER
021258
999 9.1 Hr
002 9.4 Hr
011 9.3 Hr
019 9.3 Hr
029 9.5 Hr
032 9.3 Hr
033 9.3 Hr
040 9.3 Hr
042 8.5 Jo
043 9.3 Hr
047 8.4 Jo
061 8.6 My

T PER
021258
062 8.6 Pt
063 8.5 My
063 8.7 Ah
064 8.6 Jo
067 8.5 Me
068 8.6 El
071 8.5 Jo
072 8.7 Ah
073 8.7 My
075 8.7 BL
078 8.8 BL
086 8.6 BL

Z CEP
021281
062 12.5 Pt

o CET
021403
028 9.2 En
042 8.8 Jo
042 9.4 Cy
047 9.4 Cy
047 8.8 Jo
057 9.2 Cy
058 9.2 Ah
058 9.0 Me
060 9.0 Ah
060 8.9 L
060 8.9 Mn
062 8.9 Cy
062 8.6 Jo
062 8.9 Pt
063 9.0 Ah
064 9.1 Wd
064 8.9 Hf
064 9.1 Mn
068 8.7 Jo
069 9.0 Oy
069 8.7 L
071 8.3 Jo
071 8.9 Ah
071 9.0 Gs
072 8.9 Ah
072 8.9 Mn
072 8.8 Me
075 9.0 Wd
075 8.9 BL
075 8.9 Cy
078 8.6 Cy
078 9.0 BL
086 8.7 BL
088 8.5 Sf

S PER
021558
042 9.0 Jo
042 9.0 Sz
047 9.2 Jo
061 9.7 My

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1933.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
S PER	R TRI	R HOR	Y PER	W TAU	X CAM
021558	023133	*025050*	032043	042215	043274
062 9.2 Cy	060 6.8 Ah	020 10.3 Bl	071 8.8 Ah	047 11.4 Jo	060 12.1 L
062 9.5 Pt	062 6.5 Jo	028 11.2 En	072 8.7 Ah	048 11.1 L	062 12.1 Pt
063 9.1 My	062 6.6 Se	029 11.2 Ht	073 8.3 El	057 11.6 Jo	065 11.9 Me
063 9.4 Ah	062 6.8 Gy	034 10.9 Bl	073 8.2 My	057 11.6 Cy	068 11.7 Me
064 8.8 Jo	062 6.5 Pt	037 10.8 Sl	075 8.3 BL	062 12.0 L	068 11.5 B
067 9.5 Me	063 7.0 Ah	039 11.8 Ht	078 8.4 BL	062 11.5 Pt	069 11.7 L
068 9.4 El	064 6.9 Me	040 11.6 En	082 8.6 Sq	068 12.5 El	072 11.1 Me
071 8.8 Jo	065 7.0 Ra	T HOR	086 8.3 BL	068 11.4 Jo	R DOR
072 9.4 Ah	066 7.0 Ra	*025751*	R PER	068 12.4 B	*043562*
073 9.4 My	067 6.9 Ra	014 8.9 Sl	032335	070 11.4 Me	014 5.2 Sl
075 9.5 BL	068 6.9 Ra	018 10.3 Ht	042 8.5 Jo	072 12.5 L	020 5.6 Bl
075 9.2 Cy	068 6.1 Jo	020 9.9 Bl	047 8.6 Jo	073 11.6 Cy	028 5.5 En
078 9.4 BL	068 6.4 Se	028 10.8 En	048 8.8 L	078 12.3 B	029 5.4 Ht
086 9.3 BL	070 7.0 Ra	029 10.9 Ht	057 8.8 Jo	S TAU	034 5.6 Bl
R CET	071 7.0 Ra	034 11.0 Bl	062 8.6 Jo	042309	037 5.4 Sl
022000	071 6.0 Jo	037 11.6 Sl	062 8.6 L	044 13.1 Wr	039 5.5 Ht
042 10.0 Jo	071 7.0 Ah	039 11.3 Ht	062 9.2 Pt	062 14.0 Pt	040 5.4 En
060 10.4 L	071 5.7 Gs	040 11.3 En	064 8.5 Jo	066 13.8 B	R CAE
062 10.6 Jo	072 7.1 Ah	U ARI	071 8.8 Jo	T CAM	*043738*
068 10.8 Jo	072 7.0 Ra	030514	071 8.2 Gs	043065	018 7.6 Ht
069 11.2 L	073 7.2 Ad	062 14.1 L	072 9.0 L	042 8.4 Jo	020 7.3 Bl
069 10.7 Me	073 6.9 Ra	068 13.3 El	073 9.1 My	047 8.5 Jo	029 7.4 Ht
RR PER	074 6.9 Ra	073 14.5 L	073 9.0 El	047 8.5 Ko	034 8.3 Bl
022150	075 6.8 Wd	X CET	NOV PER	048 8.5 L	039 8.3 Ht
043 8.4 Jo	083 7.0 Ra	*031401*	032443	057 8.8 Jo	040 8.8 En
048 8.6 L	T ARI	043 9.3 Jo	062 13.2 Pt	060 9.5 Ko	R PIC
062 9.2 Pt	024217	047 9.6 Jo	T FOR	062 8.9 Jo	*044349*
062 9.1 L	042 10.4 Jo	058 9.7 Jo	*032528*	062 9.2 L	018 7.6 Ht
064 10.4 Jo	047 10.2 Jo	060 9.8 L	049 9.3 L	062 9.9 Pt	020 7.3 Bl
068 10.6 Jo	057 10.4 Jo	062 9.6 Jo	059 9.6 L	068 9.2 Jo	029 7.9 Ht
068 9.9 El	058 10.5 Me	062 9.7 Gy	064 9.2 L	068 9.5 El	035 8.0 Bl
072 10.0 L	060 10.8 Ko	062 9.8 Pt	072 8.9 L	069 9.6 L	039 8.6 Ht
R FOR	062 9.8 Jo	063 9.4 My	X PER	070 9.9 Ko	V TAU
022426	070 10.1 Me	066 9.9 B	034930	071 9.4 Jo	044617
020 10.0 Bl	W PER	068 10.0 Jo	058 6.5 Mc	075 10.0 BL	062 13.6 Pt
034 10.8 Bl	024356	071 10.3 Jo	059 6.3 Mc	078 10.0 BL	064 12.7 Jo
069 11.1 Me	042 9.2 Jo	072 9.9 L	060 6.1 Mc	078 10.1 Hf	066 14.2 B
U CET	047 9.4 Jo	072 10.4 Me	061 6.2 Mc	086 10.4 BL	068 13.6 Me
023813	057 9.4 Jo	073 10.3 My	062 6.4 Mc	RX TAU	073 13.4 El
058 11.5 Jo	057 10.1 Cy	073 10.4 El	063 6.5 Mc	043208	R ORI
060 12.7 L	058 9.7 Me	Y PER	065 6.4 Mc	062 13.8 L	045307
062 12.8 Pt	059 10.0 Ry	032043	067 6.2 Mc	066 13.7 B	048 9.5 L
064 11.2 Jo	059 9.8 Mc	042 8.2 Jo	069 6.4 Mc	068 13.2 El	062 9.4 L
069 12.1 Me	060 10.1 Ko	047 8.3 Jo	071 6.2 Mc	072 13.5 L	068 9.5 B
072 12.2 L	060 9.8 Mc	057 8.2 Jo	T ERI	R RET	069 9.7 Me
075 11.8 BL	062 9.3 Jo	058 8.6 Mc	*035124*	*043263*	072 9.7 L
078 11.7 BL	062 9.9 Pt	058 8.9 Ah	043 10.2 Jo	014 11.0 Sl	078 9.5 B
086 11.5 BL	064 10.0 Ry	059 8.4 Mc	W ERI	020 11.5 Bl	088 9.9 Sf
RR CEP	068 9.5 Jo	060 8.3 Ko	*040725*	028 11.8 En	R LEP
022980	068 10.1 El	060 8.5 Mc	043 12.4 Jo	029 12.4 Ht	*045514*
062 13.0 Pt	069 9.7 Mc	061 8.5 Mc	063 12.2 Me	034 11.8 Bl	014 7.7 Sl
R TRI	071 9.4 Jo	062 8.1 Jo	R TAU	037 12.0 Sl	036 7.6 Sl
023133	073 10.1 Ry	062 8.6 Pt	042209	039 12.5 Ht	042 7.6 Jo
042 6.7 Jo	075 10.3 Cy	063 8.7 Mc	044 12.2 Wr	040 12.2 En	047 7.6 Jo
047 6.7 Jo	R HOR	063 8.9 Ah	066 13.5 B	X CAM	047 8.0 Ko
055 7.0 Oy	*025050*	068 8.0 Jo	W TAU	043274	060 9.0 Ko
058 6.6 Jo	014 10.2 Sl	069 8.9 Mc	042215	042 11.5 Jo	060 9.2 Mn
058 7.0 Ah	018 10.9 Ht	071 8.2 Jo	042 11.0 Jo	048 12.0 L	061 7.5 Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1933.

J.D.Est.	Obs.	J.D.Est.	Obs.	J.D.Est.	Obs.	J.D.Est.	Obs.	J.D.Est.	Obs.	J.D.Est.	Obs.
R LEP		R AUR		W AUR		T ORI		RR TAU		SU TAU	
045514		050953		052036		*053005a*		053326		054319	
061	7.5 L	063	10.7 Ah	073	12.5 Ma	068	10.5 Jo	065	13.0 L	064	9.5 Gy
062	7.4 Jo	064	10.2 Mn	073	13.2 El	068	10.4 Pt	065	12.5 Me	064	9.6 L
062	8.4 Gy	071	11.2 Jo	S ORI		069	10.3 Pt	066	12.5 Me	065	9.6 L
064	8.6 Wd	071	10.9 Ah	*052404*		069	10.0 Me	066	12.7 B	065	9.7 Me
064	8.7 Hf	072	10.3 Mn	043	10.0 Jo	069	10.3 L	066	13.2 L	066	9.7 Me
064	9.0 Mn	T PIC		061	10.4 Pt	070	10.2 Me	067	12.3 Me	066	9.5 B
068	7.3 Jo	*051247*		062	10.2 Gy	070	10.0 Pt	068	12.1 Me	066	9.5 L
069	8.7 Oy	018	8.4 Ht	062	10.5 Jo	071	10.5 Jo	068	12.1 L	067	9.7 Me
071	7.3 Jo	020	8.0 Bl	063	10.0 B	071	10.1 B	068	11.8 Pt	068	9.6 Me
072	7.5 L	029	8.0 Ht	068	10.3 Jo	071	10.2 Me	069	11.9 Pt	068	9.5 L
072	9.2 Mn	036	7.9 Bl	068	10.4 El	072	10.3 L	069	11.9 Me	068	9.7 Pt
079	8.9 Hf	039	8.2 Ht	071	10.0 Jo	072	10.1 Me	069	11.8 L	069	9.6 Pt
080	7.8 Me	T COL		071	9.9 B	073	10.2 L	070	12.1 Me	069	9.5 L
V ORI		*051533*		073	10.7 Ma	073	9.9 Ma	070	11.9 Pt	069	9.7 Me
050003		018	7.8 Ht	T ORI		073	10.0 My	071	11.6 Me	070	9.7 Me
042	10.0 Jo	020	7.3 Bl	*053005a*		073	10.5 Cy	072	11.0 Me	070	9.6 Pt
048	9.4 L	029	7.0 Ht	011	11.2 Hr	075	10.5 Cy	072	11.7 L	071	9.6 Me
058	9.0 Jo	036	7.4 Bl	020	10.2 Hr	078	10.6 Cy	073	10.9 L	072	9.5 Me
061	9.6 Pt	039	6.9 Ht	031	10.7 Hr	078	10.4 Pt	076	12.0 Pt	072	9.5 L
062	9.2 L	S AUR		032	10.4 Hr	080	10.0 Me	078	11.8 Pt	073	9.4 L
062	9.0 Jo	052034		033	10.4 Hr	085	10.6 Pt	080	12.3 Me	073	9.5 Ma
068	9.0 Jo	042	8.6 Jo	034	10.4 Hr	AN ORI		RU AUR		073	9.8 Cy
068	9.5 B	047	8.6 Jo	040	10.7 Hr	*053005t*		053337		073	9.5 El
072	9.5 L	047	8.6 Ko	041	10.5 Hr	058	11.6 Me	061	[12.4 Pt	076	9.6 Pt
078	9.3 B	057	8.9 Jo	042	10.4 Hr	073	11.4 Ma	064	13.0 Jo	078	9.6 Pt
T LEP		058	9.2 Mc	042	10.5 Jo	S CAM		U AUR		078	9.2 Cy
050022		059	9.4 Mc	043	10.5 Jo	053068		053531		080	9.6 Me
020	10.5 Bl	060	8.6 Ko	043	10.3 Hr	042	8.5 Jo	048	14.0 L	085	9.5 Pt
035	10.5 Bl	060	9.4 Mc	047	10.1 Jo	047	8.5 Jo	062	14.1 L	S COL	
042	9.9 Jo	061	8.9 My	047	10.0 Ko	057	8.6 Jo	062	13.6 B	*054331*	
047	10.0 Jo	061	8.2 Pt	048	10.1 L	061	9.0 Pt	070	13.5 B	029	[13.1 Ht
061	9.1 Pt	061	9.4 Mc	050	9.9 Ko	062	8.6 Jo	073	13.7 L	036	[12.6 Bl
062	8.7 Jo	062	9.4 Mc	058	10.2 Me	068	8.5 Jo	SU TAU		039	[13.1 Ht
062	9.2 Ko	062	8.9 Jo	059	10.1 Me	071	8.7 Jo	054319		Z TAU	
068	8.3 Jo	062	9.3 Gy	059	10.0 L	073	8.9 El	042	9.2 Cy	054615a	
071	8.5 Jo	063	9.2 My	060	10.0 Me	RR TAU		046	9.5 L	046	13.3 L
S PIC		064	9.2 Gy	061	10.2 L	053326		047	9.4 Ko	062	11.6 L
050848		065	9.1 Mc	061	9.8 My	046	11.8 L	047	9.2 Cy	068	11.3 L
029	[12.9 Ht	067	9.3 Mc	061	10.1 Pt	047	12.0 Ko	048	9.6 L	073	10.5 Ma
035	[13.4 Bl	068	8.6 Jo	062	9.8 Pt	048	11.8 L	050	9.6 Ko	RU TAU	
AE AUR		069	9.0 Mc	062	9.8 Ko	057	12.0 Pt	057	9.2 Cy	054615c	
050934		070	8.8 B	062	10.4 Jo	058	12.1 Me	057	9.6 Pt	046	12.8 L
058	5.8 Mc	073	9.4 El	062	10.1 L	059	12.1 Me	058	9.7 Me	062	13.3 L
059	6.0 Mc	073	9.1 My	063	9.7 Bc	059	12.1 Pt	059	9.6 Me	073	12.8 Ma
060	5.9 Mc	075	9.2 BL	063	9.8 My	059	12.3 L	059	9.5 L	R COL	
061	5.7 Mc	078	9.0 BL	063	10.0 Me	060	12.1 Me	059	9.7 Pt	*054629*	
062	6.0 Mc	086	9.0 BL	063	10.0 B	061	12.3 L	060	9.6 Me	029	[13.0 Ht
065	5.8 Mc	W AUR		064	10.0 Me	061	12.0 Pt	061	9.6 L	036	12.8 Bl
067	5.9 Mc	052036		064	9.9 Ko	062	12.0 Pt	061	9.7 Pt	039	[13.0 Ht
069	5.7 Mc	042	11.6 Jo	064	9.8 Cy	062	12.7 Cy	062	9.7 Pt	α ORI	
R AUR		047	11.5 Jo	064	10.1 L	062	12.2 L	062	9.8 Ko	054907	
050953		048	11.8 L	065	10.2 L	062	12.2 Gy	062	9.2 Cy	058	1.1 Mc
047	11.0 Jo	057	12.0 Jo	065	10.0 Me	063	12.3 Me	062	9.7 Gy	059	1.0 Mc
057	11.0 Jo	061	12.4 Pt	066	10.1 Me	064	12.1 Me	062	9.5 L	062	1.0 Mc
059	10.0 Mn	062	12.4 B	066	10.2 L	064	12.5 Ko	063	9.6 Me	069	1.1 Mc
060	10.9 Ah	062	12.2 L	067	10.0 Me	064	12.4 B	064	9.6 Ko	071	1.2 Mc
061	11.8 Pt	069	12.9 L	068	9.8 Me	064	12.6 L	064	9.6 Me		
062	11.2 Jo	070	12.7 B	068	10.3 L	064	12.8 Gy	064	9.5 B		

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
U ORI	R OCT	S LYN	V CMI	V GEM	R CNC
054920a	*055686*	063558	070109	071713	081112
042 6.7 Jo	020 7.7 Bl	061 13.1 Pt	048 11.3 L	069 12.2 L	078 11.0 Cy
047 6.8 Jo	029 8.8 Ht	062 13.8 L	061 11.4 Pt	073 12.7 El	V CNC
051 6.9 Ah	036 9.0 Bl	063 13.8 B	062 11.7 Gy	S CMI	081617
055 6.8 Oy	039 9.7 Ht	064 13.4 Ry	062 11.5 L	072708	043 12.0 Jo
058 7.2 Mc	X AUR	069 13.4 L	069 11.7 L	047 11.3 Ko	048 12.8 L
058 7.0 Jo	060450	071 13.7 B	R GEM	061 11.5 Pt	060 11.2 Ah
058 7.3 Ah	046 8.2 L	073 13.7 El	070122a	064 12.5 Jo	061 12.4 Pt
058 7.3 Me	060 8.4 L	X GEM	042 7.6 Jo	064 11.9 Ko	062 12.9 L
059 7.2 Mc	061 8.4 Pt	064030	047 7.5 Jo	068 12.7 Jo	064 12.6 Gy
059 7.3 Ah	065 8.5 L	043 13.7 Bn	051 7.6 Ah	T CMI	069 12.9 L
060 7.1 Mc	068 8.9 B	062 11.9 Gy	058 7.2 Ah	072811	071 11.5 Ah
060 7.2 Ah	078 9.3 B	072 11.4 Bn	059 7.1 Ah	061[12.0 Pt	078 12.1 Cy
060 7.7 Wd	088 10.2 Sf	073 11.3 Ma	060 7.2 Ah	Z PUP	RT HYA
061 7.0 Mc	V AUR	Y MON	061 6.9 Pt	*072820b*	*082405*
061 7.0 Pt	061647	065111	062 7.4 Jo	062[11.5 Gy	046 7.7 L
062 6.9 Mc	046 12.1 L	048 8.9 L	063 7.2 Ah	S VOL	050 8.2 Ko
062 6.8 Jo	062 11.7 L	061 8.7 Pt	064 7.3 Me	*073173*	061 8.0 L
062 7.6 Gy	062 11.9 Gy	062 8.7 L	064 7.2 Hf	020 12.7 Bl	064 7.9 Ko
063 7.5 Ah	064 11.4 B	064 8.8 Jo	064 7.5 Wd	029[13.2 Ht	067 8.0 Me
064 7.6 Hf	068 12.0 El	069 8.9 L	065 7.4 Ad	036 13.4 Bl	068 8.0 Pt
064 7.6 Wd	069 11.7 L	073 9.1 Ma	068 7.0 Jo	U CMI	068 7.9 L
064 7.4 Gy	071 11.5 B	X MON	071 7.3 Jo	073508	068 8.3 Jo
065 6.8 Mc	073 11.9 El	*065208*	071 7.2 Ah	048 10.5 L	071 8.2 Jo
065 6.8 Ad	V MON	048 7.9 L	072 7.3 Ah	061 10.2 Pt	073 8.3 El
067 6.8 Mc	*061702*	062 8.5 L	073 7.3 Ad	062 10.0 L	R CHA
068 8.1 B	061[12.5 Pt	062 8.7 Gy	075 7.5 Wd	062 10.2 Cy	*082476*
069 7.5 Oy	075[12.3 Wd	072 8.5 L	079 7.4 Hf	064 10.3 Jo	014 9.1 Sl
069 6.9 Mc	AG AUR	R LYN	Z GEM	068 10.1 Jo	020 10.2 Bl
070 6.9 Mc	062047	065355	070122b	069 10.0 L	029 11.0 Ht
071 7.4 Ah	046 9.3 L	043 8.6 Jo	061 12.4 Pt	071 10.0 Jo	036 11.3 Bl
072 7.6 Ah	060 9.7 L	048 8.8 L	TW GEM	073 9.8 Cy	037 11.0 Sl
074 7.1 Ad	064 9.5 L	059 9.5 Ah	070122c	S GEM	039 11.5 Ht
075 7.7 Wd	073 9.4 L	060 9.4 Ah	061 8.2 Pt	073723	U CNC
078 7.7 B	UU AUR	061 9.4 Pt	R CMI	064 12.3 Jo	083019
079 7.9 Hf	062938	062 9.5 L	070310	068 12.0 Jo	064[14.3 L
079 7.6 Sr	058 6.2 Mc	063 9.5 Ah	042 10.0 Jo	W PUP	073 14.0 El
079 7.6 Sv	059 6.0 Mc	064 9.7 Mn	048 10.7 L	*074241*	X UMA
083 7.3 Ad	060 6.1 Mc	068 9.8 Mn	057 9.7 Jo	020 8.7 Bl	083350
094 8.5 Sr	061 6.1 Mc	069 9.6 L	061 10.5 Pt	029 9.6 Ht	042 11.6 Jo
V CAM	062 6.0 Mc	071 9.6 Ah	062 10.3 Gy	036 10.2 Bl	047 11.8 Jo
054974	065 5.9 Mc	072 10.0 Mn	062 9.5 L	039 10.1 Ht	073 13.9 El
062 14.0 L	067 5.9 Mc	073 10.2 Ma	064 9.4 Jo	T GEM	S HYA
069 14.2 L	069 5.9 Mc	073 9.7 El	068 9.5 Jo	074323	084803
Z AUR	U LYN	RS GEM	069 9.7 L	064[12.4 Gy	059 7.5 Ah
055353	063159	065530	071 9.3 Jo	073[14.0 El	067 7.7 Me
057 10.4 Pt	073[13.3 El	043 9.6 Jo	R VOL	U PUP	068 7.8 Pt
059 10.4 Pt	R MON	058 9.9 Me	*070772*	*075612*	068 8.2 Jo
063 10.5 B	063308	061 10.1 Pt	029[13.4 Ht	068 9.8 Me	071 7.8 Ah
065 10.8 Me	043 11.6 Jo	064 9.6 Jo	039[13.4 Ht	R CNC	071 8.0 Jo
067 10.4 Mc	071 11.7 Jo	068 9.6 Jo	L_2 PUP	081112	072 8.0 Ah
069 10.3 Mc	Nov PIC	072 10.1 Me	*071044*	042 11.0 Jo	073 7.7 El
069 10.5 Pt	*063462*	073 10.2 Ma	015 5.6 Sl	061 11.2 Pt	T HYA
070 10.6 B	029 8.7 Ht	Z CMA	036 4.9 Sl	062 10.8 Jo	*085008*
073 11.2 El	039 8.7 Ht	*065011*	V GEM	068 10.9 Jo	048 11.2 L
076 10.4 Pt	039 8.7 En	036 9.5 Sl	071713	069 11.1 Me	062 11.7 L
078 10.7 Pt	S LYN	V CMI	048 11.4 L	071 10.6 Jo	068 11.9 Me
085 10.7 Pt	063558	070109	061 12.0 Pt	071 11.5 Ah	068 11.3 Pt
	061 13.1 Ry	042 10.4 Jo	062 11.7 L	075 11.0 Wd	069 12.1 L

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1933.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T CNC	R LEO	U UMA	W CEN	RS UMA	RU VIR
085120	094211	100860	*115058*	123459	124204
042 8.0 Jo	042 7.5 Jo	072 6.7 Mn	039 9.5 Ht	060 8.9 Ah	068 13.4 L
047 8.1 Jo	047 7.4 Jo	Z CAR	SU VIR	060 9.2 Ry	069 13.6 Pt
062 8.3 Jo	051 6.9 Ah	*101058a*	120012	062 9.1 Jo	U VIR
068 8.3 Jo	058 6.4 Ah	036[12.3 Bl	062 11.6 L	063 9.2 Ah	124606
068 8.0 Pt	062 6.2 Jo	039[12.3 Ht	069 11.5 L	063 9.4 Bn	046 11.6 L
069 8.6 Mc	063 6.2 Ah	W VEL	069 11.0 Pt	064 9.0 Cy	061 12.4 L
071 8.2 Jo	067 6.2 Mc	*101153*	078 9.6 Cy	064 8.4 Jo	068 12.5 L
V UMA	068 5.8 Pt	020 11.6 Bl	T VIR	065 9.2 Ry	069 12.0 Pt
090151	068 6.2 Jo	036 11.9 Bl	120905	068 8.8 Jo	RV VIR
048 10.7 L	069 6.4 Oy	RZ CAR	048 9.5 L	068 9.5 Mc	*130212*
058 10.2 Mc	071 6.1 Jo	*103270*	061 9.9 L	069 9.5 Pt	061 11.4 L
059 10.4 Mc	071 5.9 Ah	039 10.0 Ht	068 10.1 L	071 8.9 Ah	068 11.8 L
060 10.6 L	072 6.0 Ah	R UMA	069 10.1 Pt	071 8.7 Jo	U OCT
061 10.5 Mc	073 6.2 Ad	103769	R CRV	072 8.9 Ah	*131383*
062 10.4 Mc	074 6.4 Wd	058 12.2 Jo	*121418*	072 9.8 Bn	017 8.3 Bl
065 10.4 Mc	083 6.1 Wd	062 11.7 Jo	061 12.2 L	072 9.2 Mn	018 8.5 Ht
065 10.3 Mc	083 6.1 Hf	062 12.4 Gy	068 13.0 L	073 9.1 Ry	029 8.5 Ht
067 10.3 Mc	I CAR	064 12.4 Gy	069 13.5 Pt	073 9.3 El	033 8.2 Bl
068 10.7 L	*094262*	064 12.2 Cy	SS VIR	074 9.4 Wd	039 8.5 Ht
069 10.3 Mc	014 4.2 Sl	068 11.7 Jo	122001	077 9.1 Cy	W VIR
071 10.1 Jo	037 4.1 Sl	068 12.5 Pt	046 7.9 L	078 9.2 Sh	*132002*
W CNC	Y HYA	071 11.8 Jo	050 7.4 Ko	078 9.4 Wd	070 9.9 Ko
090425	*094622*	073 11.7 El	061 8.0 L	078 9.3 Hf	V VIR
048 11.4 L	068 6.5 Pt	074 11.0 Wd	068 7.9 L	079 9.2 Sh	*132202*
068 11.6 L	Z VEL	078 11.6 Cy	070 8.2 Ko	083 9.5 Wd	062 12.0 L
068 11.9 Pt	*094953*	V HYA	T CVN	083 9.4 Hf	R HYA
069 11.3 L	036 12.5 Bl	*104620*	122532	S UMA	*132422*
078 12.6 Cy	039 12.7 Ht	048 7.0 L	042 9.8 Jo	123961	061 7.9 L
RW CAR	V LEO	050 6.9 Ko	047 9.8 Jo	042 7.9 Jo	068 7.7 L
091868	095421	061 6.6 L	064 9.6 Cy	042 8.5 Sz	069 7.6 Pt
020 12.2 Bl	021 12.4 Cy	068 7.0 L	069 9.9 Pt	047 8.3 Jo	S VIR
036 11.8 Bl	042 12.5 Jo	068 6.8 Pt	071 9.9 Jo	051 8.6 Ah	*132706*
039 11.8 Ht	058 11.7 Jo	070 7.2 Ko	Y VIR	058 9.0 Ah	069 10.3 Pt
Y VEL	064 11.3 Jo	W LEO	*122803*	059 9.2 Mc	RV CEN
092551	064 11.8 Cy	104814	061 11.2 L	060 9.3 Mc	*133155*
036[12.9 Bl	068 11.0 Jo	048 12.1 L	068 11.7 L	060 9.1 Mn	017 8.2 Bl
039[12.9 Ht	068 11.0 Pt	064 12.0 L	U CEN	060 9.1 Ah	039 8.6 Ht
R CAR	071 10.4 Jo	068 12.0 Pt	*122854*	061 9.4 Mc	T UMI
092962	073 10.5 El	S LEO	039 12.3 Ht	062 9.4 Jo	133273
014 8.9 Sl	078 10.0 Cy	110506	T UMA	063 9.5 Mc	061 9.5 L
020 9.0 Bl	RR CAR	046 11.5 L	123160	063 9.4 Ah	062 9.9 Cy
036 9.1 Bl	*095458*	064 11.0 L	062 12.6 Jo	064 9.6 Jo	064 9.6 Jo
037 9.2 Sl	039 8.0 Ht	068 11.6 Pt	062 12.9 Gy	064 9.2 Mn	072 9.5 L
039 9.8 Ht	RV CAR	078 10.1 Cy	068 12.7 Me	065 9.5 Mc	073 9.4 Cy
X HYA	*095563*	RY CAR	069 13.0 Pt	068 9.7 Me	R CVN
093014	036[12.5 Bl	*111561*	073 12.6 El	068 9.8 Jo	134440
064 11.5 Gy	039[13.1 Ht	039 12.3 Ht	R VIR	069 9.7 Mc	043 8.8 Jo
068 13.0 Pt	S CAR	RS CEN	123307	069 9.6 Pt	047 8.6 Jo
Y DRA	*100661*	*111661*	069 10.6 Pt	071 9.9 Jo	058 8.3 Ah
093178	014 5.7 Sl	020 8.3 Bl	RS UMA	071 9.6 Ah	060 8.2 Ah
062 14.4 L	020 5.5 Bl	036 9.1 Bl	123459	072 9.6 Ah	063 7.9 Ah
073 14.6 L	036 6.1 Bl	039 9.6 Ht	042 10.6 Jo	072 9.5 Mn	069 7.9 Pt
R LMI	037 5.5 Sl	X CEN	043 10.8 Bn	073 9.6 El	071 7.9 Ah
093934	039 5.8 Ht	*114441*	045 10.5 Bn	074 10.0 Wd	072 7.9 Ah
062 12.1 Gy	U UMA	039[13.1 Ht	047 10.4 Jo	078 10.1 Wd	T APS
064 12.1 Gy	100860	AD CEN	048 9.7 Bn	RU VIR	*134677*
068 12.2 Pt	060 6.6 Mn	*114858*	058 9.5 Jo	124204	017 9.7 Bl
	064 6.6 Mn	039 9.7 Ht	059 8.9 Ah	061 13.3 L	033 10.7 Bl

Variable Star Observations Received During January, 1933.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

T Aps
134677
039 10.5 Ht

RR Vir
135908
069 12.2 Pt

Z Boo
140113
046 11.0 L
064 12.0 L

Z Vir
140512
069[12.7 Pt

R Cen
140959
013 6.0 Sl
017 6.5 Bl
033 6.8 Bl
039 6.8 Ht

U UMi
141567
042 10.3 Jo
042 10.0 Sz
047 9.7 Jo
058 9.3 Jo
060 9.4 Ah
062 9.4 Jo
062 9.2 Cy
063 9.4 Ah
067 9.0 Me
068 8.8 Jo
069 9.1 Pt
071 9.1 Ah
072 9.0 Ah
072 9.0 Mn
073 8.7 Cy

S Boo
141954
042 9.8 Jo
047 9.7 Jo
060 8.6 L
062 8.4 Gy
064 8.5 L
068 8.5 Jo
069 8.0 Pt
071 8.4 Jo

RS Vir
142205
050 9.7 Ko
061 10.0 L
068 10.1 L
070 9.8 Ko

V Boo
142539a
043 7.7 Jo
047 7.5 Jo
058 8.0 Ah
060 8.0 Ah
069 7.9 Pt
071 8.2 Ah

R Cam
142584
039 8.7 Th
062 9.4 Cy
073 9.6 Cy

R Boo
143227
043 9.2 Jo
047 8.9 Jo
059 8.4 Ah
069 7.5 Pt

V Lib
143417
062[11.4 L

U Boo
144918
073 12.0 Cy

Y Lup
145254
017[12.8 Bl

S Aps
145971
013 11.0 Sl
017 10.9 Bl
018 11.6 Ht
033 10.7 Bl
037 11.0 Sl
039 10.9 Ht

RT Lib
150018
069 12.9 Pt

T Lib
150519
062 10.5 L
069 10.6 L

Y Lib
150605
069[12.6 Pt

S Lib
151520
062 8.1 L
069 8.3 L
069 8.3 Pt

S Ser
151714
061 10.5 L
068 10.6 L
069 10.8 Pt
078 11.1 Cy

S CrB
151731
050 8.4 Ko
069 9.7 Pt
070 9.9 Ko

RS Lib
151822
062 10.5 L
069 10.9 L

RU Lib
152714
062 10.1 L
069 11.3 Pt
072 10.9 L

R Nor
152849
017 11.8 Bl

S UMi
153378
042 11.2 Jo
047 11.5 Jo
060 12.0 Ah
062 11.6 Ko
064 11.0 Jo
065 11.7 Me
068 10.8 Jo
069 11.7 Pt
071 10.6 Jo
072 11.7 Ah

R CrB
154428
997 6.0 Hr
999 5.9 Hr
000 5.9 Hr
010 5.9 Hr
011 5.9 Hr
019 5.9 Hr
030 5.9 Hr
041 6.0 Hr
046 6.1 L
046 6.0 Cy
047 6.0 L
048 6.0 L
050 6.0 Ko
054 5.8 Ra
055 5.8 Ra
059 6.0 Cy
061 6.0 L
062 6.0 L
062 6.0 Cy
064 6.0 L
064 6.0 Gy
065 5.9 L
065 5.9 Me
068 6.0 Me
068 5.8 Ra
068 6.0 L
069 6.0 L
069 5.9 Me
069 5.8 Pt
070 5.8 Ra
070 5.7 Ko
071 6.9 Me
072 5.9 Me
072 6.1 L
073 6.0 Cy
073 5.9 Ra
074 5.9 Me
076 5.8 Cy

R CrB
154428
077 6.0 Cy
078 6.1 Cy
078 5.8 Pt
079 6.0 Me

X CrB
154536
047 9.6 L
061 9.2 L
068 9.2 L
069 9.2 Pt
078 9.6 Cy

R Ser
154615
069 7.2 Pt
078 7.6 Cy

V CrB
154639
069 7.9 Pt
078 8.9 Cy

Z CrB
155229
061 12.6 L

RZ Sco
155823
069 9.5 Pt

R Her
160118
069 12.5 Pt

U Ser
160210
069 9.1 Pt
077 9.1 Cy

SX Her
160325
047 8.1 L
061 8.2 L
065 8.2 L
069 8.0 Pt
070 8.0 Ko
078 8.1 Pt

RU Her
160625
047 11.2 L
061 11.6 L
065 11.7 L
069 11.6 Pt

W CrB
161138
043 9.5 Jo
047 9.7 Jo
069 11.2 Pt

W Oph
161607
064 12.0 L

V Oph
162112
064 10.4 L
069 9.5 Pt

U Her
162119
069 11.1 Pt

SS Her
162807
061 9.5 L
065 9.7 L
069 9.9 Pt

W Her
163137
069 9.9 Pt
070 9.9 Ko
074 9.3 El

R UMi
163172
042 10.0 Jo
047 9.8 Jo
048 10.5 L
057 9.5 Jo
060 9.8 Mc
061 10.4 L
062 10.0 Mc
062 9.6 Jo
064 10.3 Me
065 9.9 L
068 9.5 Jo
071 9.4 Jo

R Dra
163266
042 7.2 Jo
047 7.4 Jo
051 7.6 Ah
053 7.6 Ah
057 8.0 Jo
058 7.8 Ah
059 7.9 Mn
060 7.8 Ah
060 8.0 Wd
062 8.0 Jo
063 8.0 Ah
064 7.7 Mn
064 8.0 Wd
065 7.5 Ad
067 8.3 Me
068 7.8 Mn
068 8.0 Jo
069 7.7 Pt
071 7.9 Jo
071 8.0 Ah
072 8.1 Ah
072 7.8 Mn
073 7.6 Ad
074 7.9 El
075 8.1 Wd

S Her
164715
042 10.4 Jo
047 10.0 Jo
069 9.3 Pt

RS Sco
164844
018 11.4 Ht
033 11.3 Bl

RR Sco
165030a
013 5.6 Sl
017 5.9 Bl
018 6.1 Ht
033 6.8 Bl

RV Her
165631
047 10.9 L
062 11.4 L
068 11.3 L
069 11.7 Pt

RT Her
170627
069[12.9 Pt

RW Sco
170833
017 9.1 Bl
033 9.5 Bl

RS Her
171723
042 12.5 Jo
069 12.1 Pt

S Oct
172486
017 8.8 Bl
029 9.1 Ht
033 9.0 Bl
039 9.7 Ht

RU Oph
172809
047 12.5 L
065 11.7 L
069 11.2 Pt

RU Sco
173543
017 8.6 Bl
028 9.4 En
033 9.0 Bl

SV Sco
174135
017 10.3 Bl
033 10.5 Bl

W Pav
174162
033 12.0 Bl
039 11.4 En
039 11.5 Ht

U Ara
174551
018 8.6 Ht
029 8.6 Ht
039 9.6 En

RT Oph
175111
069 12.5 Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1933.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RY HER	SV HER	R LYR	RT LYR	RY SCO	TY CYG
175519	182224	185243	185737	*191033*	192928
047 9.0 L	059 13.6 Pt	058 4.1 Mc	043 11.0 Jo	893 7.3 Ht	047 12.5 L
059 9.3 Pt	062 12.6 L	059 4.3 Mc	047 13.5 L	914 7.4 Ht	059 11.5 Pt
062 9.3 L	068 12.9 L	060 4.3 Mc	062 14.3 L	918 7.3 Ht	061 11.8 L
068 9.3 L	SV DRA	061 4.2 Mc	068 14.2 L	017 6.5 Sl	065 11.8 L
V DRA	183149	062 4.1 Mc	R AQL	017 6.9 Bl	RT AQL
175654	047 12.8 L	065 4.0 Mc	190108	018 6.3 En	193311
059 13.9 L	061 11.2 L	069 4.0 Mc	059 9.2 Pt	018 6.0 Ht	059 12.9 L
065 14.2 L	065 11.3 L	S CRA	V LYR	028 6.0 En	065 13.0 L
R PAV	RZ HER	*185437a*	190529a	029 6.2 Ht	R CYG
180363	183225	893 11.7 Ht	059[12.3 Pt	033 6.8 En	193449
018 10.5 Ht	047 11.0 L	914 11.6 Ht	RX SGR	034 6.9 Bl	042 7.2 Jo
029 9.8 Ht	062 10.1 L	918 11.7 Ht	*190818*	036 6.4 Sl	047 7.3 Jo
033 9.3 En	068 9.7 L	013 12.5 Sl	893[12.7 Ht	039 6.5 Ht	047 7.0 Ko
039 8.9 En	X OPH	017 12.0 Sl	918[12.7 Ht	039 6.8 En	051 7.4 Ah
039 8.9 Ht	183308	018 11.9 Ht	039 11.8 En	TY SGR	053 7.2 Ah
T HER	043 8.5 Jo	028 11.0 En	RW SGR	*191124*	055 7.0 Oy
180531	047 8.5 Jo	029 11.5 Ht	*190819a*	019 10.2 Bl	057 7.6 Jo
042 9.6 Jo	047 7.8 L	033 11.4 Bl	893 9.9 Ht	034 10.1 Bl	058 7.6 Ah
047 10.8 L	062 7.7 L	033 11.3 En	914 9.9 Ht	S SGR	059 7.1 Mc
059 12.5 Pt	068 7.3 L	036 11.8 Sl	918 10.2 Ht	*191319a*	059 7.0 Pt
060 12.0 Ah	RY LYR	039 11.3 Ht	018 10.0 Ht	893 10.8 Ht	060 7.2 Mc
062 12.3 L	184134	039 11.4 En	029 9.9 Ht	914 11.0 Ht	060 7.2 Ah
068 12.6 L	047 12.0 L	R CRA	039 9.9 Ht	918 11.3 Ht	060 7.3 Wd
W DRA	059 10.4 Pt	*185537a*	039 9.3 En	029[12.7 Ht	062 7.4 Mc
180565	061 10.8 L	893 12.1 Ht	S LYR	039[12.2 En	062 7.4 Jo
059[12.9 Pt	065 11.0 L	914 11.7 Ht	190925	Z SGR	062 7.5 Gy
062 15.0 L	R SCT	918 11.8 Ht	062[14.4 L	*191321*	063 7.5 Mc
X DRA	*184205*	013 13.1 Sl	X LYR	040 9.3 En	063 7.5 Ah
180666	997 5.4 Hr	029 11.1 Ht	190926	SW SGR	064 7.5 Me
062[14.5 L	999 5.3 Hr	033 11.7 Bl	059 9.0 Pt	*191331*	064 7.4 Wd
TV HER	010 5.4 Hr	036 11.3 Sl	RS LYR	019 11.8 Bl	064 7.4 Hf
181031	013 5.4 Sl	039 11.4 En	190933a	034 11.7 Bl	065 7.5 Mc
047 12.4 L	019 5.8 Hr	039 11.3 Ht	042 11.4 Sz	039 10.9 En	065 7.4 Ad
062 13.8 L	030 6.0 Hr	T CRA	043 11.8 Jo	TZ CYG	067 7.5 Mc
067 13.4 L	031 5.8 Hr	*185537b*	047 11.6 L	191350	068 7.1 El
RY OPH	032 5.8 Hr	893 12.5 Ht	059 12.4 Pt	059 11.2 Pt	068 7.7 Jo
181103	033 5.8 Hr	914 12.5 Ht	062 11.7 Gy	062 10.5 Jo	069 7.5 Mc
043 10.5 Cy	040 5.8 Hr	918 12.5 Ht	062 12.2 L	071 10.6 Jo	069 7.7 B
W LYR	043 6.2 Hr	013 12.8 Sl	068 12.8 L	U LYR	069 7.4 Oy
181136	047 6.2 L	028 11.7 En	RU LYR	191637	071 7.4 Ko
042 11.5 Jo	047 6.3 Cy	033 13.2 Bl	190941	042 9.8 Jo	071 7.6 Mc
047 12.0 Jo	051 6.7 Bc	033 11.5 En	059[12.3 Pt	047 9.6 Jo	071 7.6 Jo
047 11.7 L	051 6.7 Bf	035 13.0 Sl	U DRA	057 9.5 Jo	071 7.7 Ah
057 12.3 Jo	055 6.5 Pt	039 12.5 Ht	190967	059 9.5 Pt	072 7.8 Ah
059 12.5 Pt	057 6.5 Pt	Z LYR	047 13.2 L	062 9.4 Jo	075 7.9 Wd
062 12.3 Jo	057 6.3 Cy	185634	059 13.4 Pt	068 9.4 Jo	078 8.0 Wd
062 12.0 L	058 6.4 L	047 12.2 L	062 13.6 L	071 9.3 Jo	078 7.9 Hf
068 12.0 L	059 6.5 Pt	059 12.0 Pt	068 13.6 L	AF CYG	078 7.8 Sh
068 12.4 Jo	061 6.5 Pt	062 11.2 L	R SGR	192745	079 7.8 Sh
071 12.3 Jo	062 6.4 L	068 11.4 L	*191019*	051 6.9 Ah	083 7.5 Ad
RV SGR	063 6.3 Bc	SU SGR	893 11.7 Ht	053 6.8 Ah	RV AQL
182133	NOV AQL	*185722*	914 11.2 Ht	058 6.9 Ah	193509
033 11.6 Bl	184300	893 8.5 Ht	918 10.7 Ht	060 6.7 Ah	059 11.3 L
040 10.8 En	061 11.4 Pt	914 8.5 Ht	018 8.7 Ht	063 7.0 Ah	059 11.2 Pt
SV HER	RX LYR	918 8.6 Ht	029 9.5 Ht	068 6.9 Ah	065 10.7 L
182224	185032	018 8.5 Ht	039 10.1 Ht	071 6.9 Ah	T PAV
042 11.2 Jo	062[14.5 L	029 8.5 Ht	039 10.0 En	072 7.1 Ah	*193972*
047 11.1 L		039 8.5 Ht			914 12.0 Ht

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1933.

T PAV
193972
J.D.Est.Obs.
918 11.7 Ht
018 9.5 Ht
019 9.5 Bl
029 10.4 Ht
033 10.7 En
034 10.8 Bl
039 11.3 En
039 11.2 Ht

RT CYG
194048
042 11.4 Jo
047 10.4 Jo
047 10.8 Ko
057 9.7 Jo
058 9.3 Ah
059 9.3 Pt
060 9.2 Wd
060 9.3 Ah
062 9.2 Jo
062 8.9 Gy
063 9.2 Ah
064 9.1 Wd
064 8.9 Hf
068 8.6 El
068 8.4 Jo
069 8.5 B
069 8.5 Oy
071 8.5 Ah
071 8.0 Jo
071 8.4 Ko
072 8.6 Ah
075 8.5 Wd

TU CYG
194348
059 12.8 L
059 12.4 Pt
062 12.9 B
065 13.3 L

X AQL
194604
059 13.4 L
065 13.6 L

χ CYG
194632
J.D.Est.Obs.
060 6.0 Ah
060 6.0 Wd
061 5.9 Pt
061 6.0 Ra
062 6.0 Jo
062 6.0 Se
062 5.8 Gy
063 6.2 Ah
063 6.2 Ra
064 6.3 Cy
064 6.2 Wd
065 6.5 Ad
065 6.3 Ra
066 6.4 Ra
067 6.5 Ra
068 6.3 Jo
068 6.3 Ah
068 6.3 Bg
068 6.3 Se
069 6.3 Oy
070 6.6 Ra
071 6.3 Ko
071 6.4 Jo
071 6.5 Ah
071 6.5 Bg
072 6.7 Ah
072 6.8 Ra
073 7.0 Ra
075 7.3 Wd
077 6.7 Bg
078 7.5 Ra
083 7.0 Ad

S PAV
194659
014 7.0 Sl
033 8.3 En
039 8.4 En

RR SGR
194929
019 11.8 Bl
034 11.0 Bl
040 10.6 En

RU SGR
195142
893[13.2 Ht
918[13.2 Ht
018 7.9 Ht
019 7.9 Bl
029 7.9 Ht
033 7.9 En
034 8.0 Bl
039 8.2 En
039 8.1 Ht

RR AQL
195202
058 12.2 L
065 10.9 L

RS AQL
195308
058[13.1 L

Nov CYG
195553
061[12.2 Pt
069[12.2 Pt

RR TEL
195656
893[12.6 Ht
918[12.6 Ht
018[12.6 Ht
029 13.0 Ht
039[12.6 En

Z CYG
195849
059 12.9 L
061 12.6 Pt
062 13.3 B
065 12.6 L

S TEL
195855
893 12.8 Ht
914 12.6 Ht
918 12.6 Ht
034 13.1 Bl
039 12.8 En

SY AQL
200212
048 9.7 L
061 10.0 Pt
062 9.7 L
068 9.8 L

S CYG
200357
044 11.8 Wr
061 12.4 Pt
062 12.6 B
071 13.3 Wr
072 13.2 B
073 13.0 El

R CAP
200514
058 12.5 L
061 11.4 Pt

S AQL
200715a
042 9.8 Jo
058 10.5 Jo
058 10.8 Me
061 11.2 Pt
062 11.2 Jo
065 11.6 Me
068 11.7 Jo
071 11.7 Jo

RW AQL
200715b
042 9.6 Jo

RW AQL
200715b
058 9.5 Jo
061 9.2 Pt
062 9.8 Jo
068 9.8 Jo
071 9.5 Jo

R TEL
200747
019 9.6 Bl
034 10.0 Bl
039 10.6 En

RU AQL
200812
048 11.8 L
062 10.3 L
068 10.0 L

W CAP
200823
019 12.2 Bl
034 12.5 Bl

Z AQL
200906
058 9.8 B
061 10.4 Pt

R SGE
200916
042 9.6 Jo
058 9.5 Jo
058 9.7 Me
062 9.5 Jo
065 9.8 Me
068 9.1 Jo
071 9.0 Jo

RS CYG
200938
042 7.5 Jo
047 7.6 Jo
047 7.9 Ko
048 8.1 L
057 8.5 Cy
057 7.5 Jo
060 8.5 Wd
061 7.6 L
061 7.9 Pt
062 7.5 Jo
064 8.2 Cy
064 8.3 Wd
064 8.4 Hf
064 8.1 Me
065 7.8 L
065 7.5 Ad
068 7.4 Jo
070 8.3 GD
071 7.3 Jo
071 7.9 Ah
071 7.8 Ko
074 7.3 Ad
075 8.2 Wd
078 8.1 Wd

RS CYG
200938
078 8.0 Hf
078 8.3 Cy
083 7.5 Ad

R DEL
201008
048 12.6 L
061 12.6 Pt
062 12.7 L
073 13.1 L

SX CYG
201130
061[13.1 Pt

RT SGR
201139
019 11.0 Bl
034 10.7 Bl
039 10.9 En

WX CYG
201437b
042 11.5 Jo
047 11.6 Jo
048 11.8 L
057 11.7 Jo
057 11.8 Cy
058 11.8 B
061 11.8 L
061 12.0 Pt
062 11.9 Jo
064 12.0 Cy
065 11.9 L
068 12.1 Jo
071 11.9 Jo
071 11.8 Ah

V SGE
201520
042 11.0 Jo
058 11.6 Me
059 11.6 Me
064 11.3 Me
065 11.1 Me
067 11.3 Me
069 11.3 Me
071 11.1 Me
071 11.0 Jo

U CYG
201647
042 9.9 Jo
047 9.5 Jo
056 10.2 Ko
057 9.5 Jo
058 9.9 Mc
059 9.9 Mc
060 9.9 Mc
060 10.0 Ah
060 9.9 Wd
061 9.8 Pt
062 9.9 Mc
062 9.0 Jo

U CYG
201647
063 9.9 Mc
063 10.0 Ah
064 9.7 Wd
064 9.7 Hf
064 10.5 Mn
065 9.8 Mc
067 9.9 Mc
068 8.8 Jo
069 8.6 B
071 8.8 Jo
072 9.8 Mn
075 9.8 Wd
078 9.6 Wd
078 9.5 Hf
078 9.5 Sh
079 9.5 Sh
080 8.7 Me

U MIC
202240
039[12.1 En

RU CAP
202622
040 10.0 En

Z DEL
202817
048 12.9 L
062 11.9 L
069 11.5 B
073 10.9 L

ST CYG
202954
018 9.8 Ht
029 9.9 Ht
039 10.2 Ht
058 12.7 B
059 12.5 L
061 12.6 Pt
065 12.3 L

V VUL
203226
061 8.6 Pt

R MIC
203429
039[12.2 En

Y DEL
203611
059 14.0 L
065 13.9 L

S DEL
203816
042 8.8 Jo
042 8.8 Sz
047 8.8 Jo
057 8.8 Jo
061 9.5 Pt
068 8.9 Jo
069 9.2 B
071 9.0 Jo

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1933.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D. J.D.Est.Obs.

V CYG
203847
043 10.5 Jo
047 10.0 Jo
048 10.6 L
057 9.9 Jo
058 10.1 B
061 10.5 L
061 10.0 Pt
062 9.6 Jo
064 10.7 Ko
065 10.4 L
068 9.4 Jo
071 9.2 Jo
072 10.1 B

Y AQR
203005
043 9.7 Jo
047 9.5 Jo
058 9.4 Jo
061 9.1 Pt
062 9.3 Jo
068 8.9 Jo
071 9.3 Jo

T DEL
204016
042 8.8 Jo
047 8.6 Jo
048 9.2 L
057 9.2 Jo
058 9.5 B
061 9.5 Pt
062 9.1 L
062 9.4 Jo
064 9.0 Cy
068 9.5 Jo
068 9.8 L
071 9.7 Jo
072 9.7 B

V AQR
204102
043 9.3 Jo
058 9.1 L
061 9.3 Pt
065 9.0 L

W AQR
204104
058 14.0 L
065 14.0 L

U CAP
204215
019|13.1 Bl

T AQR
204405
043 8.6 Jo
047 8.8 Jo
058 9.0 Jo
059 9.5 Ah
061 9.8 Mn
061 9.5 Pt

T AQR
204405
062 9.6 Jo
063 9.6 Ah
064 10.3 Mn
068 9.8 Jo
071 10.1 Jo

RZ CYG
204846
058 11.5 B
061 12.0 Pt
071 11.2 Jo
072 11.7 B

S IND
204954
893|13.1 Ht
918|13.5 Ht
019 9.4 Bl
034 9.8 Bl
039 10.7 En

X DEL
205017
062 14.6 L
073 14.3 L

UX CYG
205030a
070|12.8 Me

RR CAP
205627
039|12.5 En

R VUL
205923a
042 9.5 Jo
047 10.6 Jo
057 11.9 Jo
061 12.5 Pt
062 12.2 Jo
062 12.0 B
068 12.5 Jo
071 12.3 Jo
071 13.0 Me
072 13.0 B

V CAP
210124
059 13.2 L

TW CYG
210129
059 14.2 L
065 14.2 L

X CAP
210221
034|12.4 Bl

RS AQR
210504
058 13.6 L
066 13.3 L

Z CAP
210516
058 13.3 L
066 13.2 L

R EQU
210812
059 8.7 L
061 9.0 Pt
064 9.2 Cy
065 9.1 B
065 8.8 L
068 9.0 Jo
071 8.9 Jo

T CEP
210868
039 7.3 Th
042 6.7 Jo
047 6.7 Jo
047 6.7 Ko
050 7.4 Th
051 7.0 Ah
053 6.9 Ah
056 7.5 Ra
058 6.8 Jo
058 6.9 Ah
058 6.4 Mn
060 6.4 Ko
060 6.9 Ah
061 7.5 Ra
061 6.6 Pt
062 6.9 Jo
063 6.9 Ah
064 6.8 Mn
065 7.2 Ad
066 7.5 Ra
068 6.6 Jo
068 7.0 Mn
070 6.5 Ko
071 6.7 Jo
071 6.7 Ah
071 7.5 Ra
072 6.7 Ah
072 6.9 Mn
073 6.9 Ad
073 7.2 Ra
075 6.4 El
075 7.1 Wd
078 6.8 Wd
078 6.9 Hf
080 6.3 Me
080 7.2 Ra
082 6.2 Sq
083 6.6 Ad

RR AQR
210903
066 13.8 L

Y PAV
211570
914 5.8 Ht
918 5.9 Ht
018 5.6 Ht
029 5.5 Ht
039 5.5 Ht

X PEG
211614
058 13.7 B
059 14.2 L
065 13.6 L
070 13.7 B

T CAP
211615
035 13.3 L
066 13.3 L

S MIC
212030
040|12.4 En

Y CAP
212814
019 12.3 Bl
034 11.0 Bl
058 11.0 L
066 11.1 L

W CYG
213244
058 6.4 Mc
058 6.6 L
059 6.3 Mc
060 6.4 Mc
062 6.2 Mc
063 6.1 Mc
065 6.2 Mc
065 6.5 L
067 6.2 Mc
069 6.3 Mc

S CEP
213678
043 9.4 Jo
044 10.1 Wr
047 9.0 Jo
058 8.8 Jo
061 9.6 Pt
062 8.9 Jo
064 9.6 Cy
068 8.7 Jo
070 10.0 B
071 8.7 Jo
071 10.1 Wr
075 10.0 Cy

RU CYG
213753
042 9.0 Jo
057 9.4 Jo
058 9.8 Ah
059 9.8 Ry
060 8.7 Mc
060 9.8 Ah
061 8.9 Pt
062 9.7 Cy
062 9.3 Jo
063 9.9 Ah
064 10.0 Ry
068 9.4 Jo
071 9.5 Jo

RU CYG
213753
071 10.1 Ah
073 9.9 Ry

RV CYG
213937
061 6.6 Pt

RR PEG
214024
042 11.0 Jo
061 10.2 Pt
068 10.2 Jo
069 10.1 B
071 10.0 Me
071 10.3 Jo

R GRU
214247
915|12.9 Ht
018 9.2 En
018 9.0 Ht
020 9.1 Bl
028 9.0 En
029 9.0 Ht
034 9.0 Bl
039 8.9 Ht
040 8.8 En

V PEG
215605
058 12.6 B
059 12.9 L
061 12.5 Pt
065 13.3 L
070 13.4 B

U AQR
215717
056 11.9 L
061 12.3 Pt
066 12.1 L

RT PEG
215934
058 9.9 B

RY PEG
220133a
062 13.0 B

RZ PEG
220133b
059 13.4 L
061 11.9 Pt
062 12.6 B
065 13.4 L

T PEG
220412
059 13.0 L
062 12.8 L
065 12.5 L

Y PEG
220613
065 13.1 B
071 12.6 Me

RS PEG
220714
059 11.5 L
061 11.5 Pt
065 11.5 L
065 10.9 B
071 11.4 Me

T GRU
221938
028 8.6 En

S GRU
221948
914 7.2 Ht
918 7.2 Ht
018 9.0 Ht
018 8.9 En
028 9.4 En
029 9.7 Ht
039 10.0 Ht
040 10.0 En

RV PEG
222129
065 14.1 L

S LAC
222439
042 8.7 Jo
047 8.3 Ko
059 8.3 L
060 8.1 Ko
061 8.3 Pt
064 8.3 L
069 8.2 B
073 8.5 El
075 8.7 BL
078 8.7 BL
086 8.5 BL

R IND
222867
918 11.1 Ht
020 12.6 Bl
028 12.0 En
029 12.2 Ht
034 12.0 Bl
039 11.7 Ht
040 11.8 En

T TUC
223462
914 8.1 Ht
918 8.1 Ht
028 13.0 En

R LAC
223841
059 12.8 L
065 12.4 L
068 11.4 Jo

RW PEG
225914
065 13.9 L
059 14.1 L

Variable Star Observations Received During January, 1933.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R Peg	W Peg	Z And	R Aqr	R Aqr	R Cas
230110	231425	232848	*233815*	*233815*	235350
042 9.6 Jo	062 10.6 Jo	047 10.4 Ko	020 8.1 Bl	071 8.6 Ko	047 12.3 Jo
061 10.5 Pt	065 10.8 L	057 10.4 Cy	028 8.3 En	Z Cas	065 12.6 B
064 10.3 Hf	068 10.5 Jo	061 10.3 Pt	029 8.1 Ht	233956	072 12.8 Me
064 10.4 Wd	S Peg	062 10.4 Cy	034 8.4 Bl	059 12.0 L	078 12.6 B
068 10.5 Jo	231508	062 10.5 Ko	039 8.0 Ht	064 12.2 B	Z Peg
071 11.2 Sf	058 8.3 Ah	064 10.8 Jo	043 8.4 Jo	065 12.0 L	235525
V Cas	059 7.8 L	068 10.4 Jo	047 8.4 Jo	078 12.5 B	059 9.5 L
230759	060 8.2 Ah	ST And	047 8.5 Ko	RR Cas	061 9.3 Pt
047 12.0 Ko	061 8.0 Pt	233335	051 8.3 Bc	235053	062 9.8 Gy
061 12.2 Pt	063 8.0 Ah	042 9.8 Jo	051 8.3 Bf	048 10.8 Bn	066 9.2 L
064 12.5 Cy	064 8.4 Wd	057 9.5 Cy	058 8.5 Jo	065 10.6 B	Y Cas
064 12.3 B	064 8.3 Hf	061 10.0 Pt	058 8.5 Me	078 10.8 B	235855
072 12.2 Me	065 7.8 L	062 9.2 Jo	058 8.4 L	V Cet	064 13.0 B
073 12.5 El	071 8.2 Ah	068 9.3 Jo	061 8.4 Pt	*235209*	SV And
078 12.4 B	072 8.5 Ah	071 9.0 Jo	062 8.7 Jo	054 12.7 Bl	235939
W Peg	072 8.3 B	072 9.2 B	063 8.5 Bc	R Tuc	061 8.1 Pt
231425	078 8.2 Ht	075 9.4 BL	065 8.7 L	*235265*	062 8.4 Jo
043 10.8 Jo	078 8.5 Wd	078 9.3 BL	068 8.6 Jo	017 13.5 Sl	068 8.4 Jo
047 10.6 Jo	V Phe	086 9.1 BL	071 8.5 Jo	028 12.9 En	071 8.0 Jo
059 10.9 L	*232746*			039 13.3 Ht	072 9.1 B
	028 12.7 En				072 8.7 Me

Rapidly Varying Irregular Variables.

Star J.D.	Est.Obs.	J.D.	Est.Obs.	Star J.D.	Est.Obs.	J.D.	Est.Obs.
005840 RX Andromedae—				060547 SS Aurigae—			
7047.6	11.5 Ko	7064.7	11.4 Gy	7064.3	12.2 L	7068.3	13.9 L
7057.6	11.7 Pt	7065.4	11.7 Ry	7064.4	12.9 Ry	7068.5	14.4 B
7058.6	11.8 Me	7065.6	11.3 Me	7064.5	12.6 Cy	7068.7	13.9 L
7059.4	11.5 Ry	7066.4	11.7 Ry	7064.6	13.2 B	7069.3	14.4 L
7059.6	11.7 Pt	7066.8	11.5 Me	7064.6	13.0 Me	7070.8	14.0 Me
7059.7	11.5 Me	7067.6	11.6 Me	7064.7	13.0 L	7071.5	14.0 B
7060.5	11.8 Ry	7068.8	11.5 Me	7064.8	12.7 Gy	7072.7	13.2 Me
7060.7	11.5 Me	7068.8	11.4 Pt	7065.3	13.4 L	7073.3	14.3 L
7061.4	11.7 Ry	7069.6	11.6 Pt	7065.4	13.2 Ry	7075.7	12.5 Cy
7061.7	11.3 Pt	7069.6	11.3 Me	7065.6	13.3 Me	7076.6	12.6 Pt
7062.6	11.1 Pt	7070.6	11.6 Pt	7065.7	13.8 L	7078.5	12.5 Cy
7062.6	11.3 Gy	7070.8	11.5 Me	7066.3	14.1 L	7080.7	12.2 Me
7062.6	11.4 Ko	7071.6	11.3 Me	7066.6	14.2 B	7085.7	12.5 Pt
7063.7	11.5 Me	7073.4	11.6 Ry	074922 U Geminorum—			
7064.4	11.6 Ry	7078.6	12.5 Pt	7046.7	14.0 L	7072.7	9.1 Me
7064.6	11.2 Ko	7085.7	11.6 Pt	7062.7	14.0 L	7072.7	8.9 L
7064.6	11.4 Me			7064.3	13.8 L	7072.8	9.1 Cy
060547 SS Aurigae—				7064.7	14.0 L	7073.3	9.1 L
7043.6	12.7 Jo	7061.3	10.8 L	7065.3	14.0 L	7073.8	9.2 Cy
7046.7	13.9 L	7061.4	11.3 Ry	7065.7	14.0 L	7073.8	8.9 El
7047.9	12.5 Cy	7061.7	11.0 Pt	7068.7	13.9 L	7073.8	9.5 Ma
7048.7	14.3 L	7062.4	11.0 L	7068.8	13.9 Me	7074.9	9.6 Ma
7058.2	14.3 L	7062.6	11.4 Ko	7069.3	14.0 L	7075.7	9.1 Cy
7059.3	11.1 L	7062.6	11.7 B	7069.7	14.0 L	7076.9	9.2 Cy
7059.4	11.5 Ry	7062.6	11.6 Gy	7070.6	12.5 B	7077.9	9.3 Cy
7059.6	11.6 Pt	7062.7	11.4 Cy	7070.8	10.4 Me	7078.6	9.4 Cy
7059.7	11.2 Me	7062.7	11.5 L	7071.6	9.5 Me	7078.6	9.4 Pt
7060.2	10.8 L	7062.7	12.1 Pt	7071.6	9.7 B	7078.6	9.8 B
7060.6	11.2 Ry	7063.6	12.3 B	7072.3	9.2 L	7080.7	10.0 Me
7060.7	11.2 Me	7063.7	12.3 Me	7072.6	9.4 B		

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1933.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
081473 Z CAMELOPARDALIS—						
	7046.7	11.6	L	7065.4	12.3	Ry
	7047.3	11.5	L	7065.6	11.8	Me
	7047.6	11.5	Ko	7065.7	11.9	L
	7048.3	11.6	L	7066.3	12.0	L
	7048.7	11.7	L	7066.4	12.2	Ry
	7057.6	11.4	Pt	7066.8	12.0	Me
	7058.2	11.5	L	7067.6	11.6	Me
	7058.6	11.5	Me	7068.3	11.9	L
	7059.3	11.8	L	7068.8	11.4	Pt
	7059.6	11.5	Pt	7068.8	11.5	Me
	7059.6	12.2	Me	7069.3	11.6	L
	7060.6	11.9	Me	7069.6	11.6	Pt
	7060.7	12.0	L	7069.6	11.7	Me
	7061.3	11.8	L	7069.7	11.5	L
	7061.7	12.0	L	7070.3	12.0	L
	7061.7	11.7	Pt	7070.6	11.7	Pt
	7062.6	12.2	Ko	7070.6	11.6	Me
	7062.7	11.6	Cy	7071.6	11.8	Me
	7062.7	11.8	L	7072.7	11.6	Me
	7062.7	12.0	Gy	7072.7	11.9	L
	7062.7	11.7	Pt	7073.6	11.9	L
	7063.7	11.9	Me	7073.5	12.3	Ry
	7064.3	12.1	L	7073.8	12.2	El
	7064.4	12.0	Ry	7076.6	12.4	Pt
	7064.6	12.1	Ko	7078.6	11.8	Pt
	7064.6	11.9	Me	7080.7	12.1	Me
	7064.7	11.8	Gy	7085.7	12.4	Pt
	7065.3	11.9	L			
094512 X LEONIS—						
	7068.8	11.9	Pt	7069.9	12.2	Pt
	7068.8	12.3	Me	7070.8	12.7	Me
	7069.8	12.3	Me			
202946 SZ CYGNI—						
	7055.7	9.4	Pt	7069.6	9.2	Pt
	7057.6	9.8	Pt	7070.6	9.2	Pt
	7059.6	9.8	Pt	7076.6	9.3	Pt
	7061.7	9.3	Pt	7078.6	8.7	Pt
	7062.7	9.0	Pt	7085.7	9.6	Pt
	7068.8	9.6	Pt			
213843 SS CYGNI—						
	6999.9	8.3	Hr	7014.9	10.5	Hr
	7000.9	8.2	Hr	7019.9	11.8	Hr
	7002.0	8.2	Hr	7029.0	12.1	Hr
	7010.8	8.8	Hr	7031.0	12.0	Hr
	7011.9	9.1	Hr	7031.9	12.0	Hr
213843 SS CYGNI—						
	7032.9	12.0	Hr	7063.2	11.8	Ah
	7033.9	12.0	Hr	7063.5	12.0	Bc
	7040.0	12.0	Hr	7063.6	11.8	My
	7040.9	12.0	Hr	7063.7	11.9	Me
	7041.9	12.0	Hr	7064.3	12.0	L
	7042.6	11.9	Sz	7064.5	11.9	Cy
	7042.7	11.9	Jo	7064.6	12.2	Ko
	7043.0	12.0	Hr	7064.6	12.1	Me
	7043.7	12.0	Jo	7065.3	12.0	L
	7043.9	12.0	Hr	7065.5	11.7	B
	7047.3	12.2	L	7065.6	11.6	Me
	7047.5	11.9	Cy	7066.3	12.2	L
	7047.6	11.9	Ko	7067.6	11.8	Me
	7047.7	11.8	Jo	7068.3	12.1	L
	7048.3	12.2	L	7068.6	11.9	El
	7051.5	11.8	Bc	7068.6	11.9	Jo
	7051.5	11.8	Bf	7068.8	11.7	Pt
	7053.3	8.6	Ah	7069.3	12.1	L
	7056.6	9.4	Ko	7069.5	11.9	B
	7057.3	9.9	Ah	7069.6	11.7	Pt
	7057.5	9.5	Cy	7069.6	11.9	Me
	7057.6	9.7	Jo	7070.6	11.8	Pt
	7057.6	9.4	Pt	7071.2	12.0	Ah
	7058.2	10.2	L	7071.6	11.8	Me
	7058.2	10.2	Ah	7071.6	11.9	Jo
	7058.6	9.6	Jo	7072.2	12.0	Ah
	7058.6	10.3	B	7072.3	12.1	L
	7058.6	9.8	Me	7072.6	11.9	B
	7059.2	10.4	L	7072.6	11.8	Me
	7059.2	10.5	Ah	7073.2	12.0	L
	7059.6	10.6	Me	7073.5	11.7	My
	7059.7	10.6	Pt	7073.6	12.0	El
	7060.2	10.8	Ah	7074.6	11.9	Wa
	7060.3	11.3	L	7075.5	12.0	El
	7060.5	11.5	Ko	7075.5	11.9	Wd
	7060.7	11.3	Me	7076.6	11.7	Pt
	7061.3	11.5	L	7078.5	12.0	Cy
	7061.5	11.7	My	7078.6	11.7	Pt
	7061.7	11.6	Pt	7078.6	11.7	Wa
	7062.3	11.9	L	7080.7	11.6	Me
	7062.5	11.8	B	7085.7	11.7	Pt
	7062.6	11.9	Ko	7088.5	11.7	Ae
	7062.6	11.9	Cy	7091.5	11.7	Jo
	7062.6	11.4	Jo	7094.5	9.0	Jo
	7062.7	11.8	Pt			

SUMMARY FOR JANUARY, 1933.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Ahnert	Ah	39	154	Buckstaff, R.N.	Bc	5	8
Aldwell	Ad	9	19	Bunting	Bg	1	3
Allen, L. B.	Ae	1	1	Cilley	Cy	43	92
Baldwin, J. M.	Bl	70	118	Eliason	El	54	57
Brown, A. N.	Bn	4	12	Ensor	En	47	67
Boutell	BL	11	33	Godfrey Club	GD	1	1
Bouton	B	66	102	Goodsell	Gs	3	3
Buckstaff, E.M.	Bf	3	3	Gregory	Gy	34	45

SUMMARY FOR JANUARY, 1933—Continued.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Hildom, A.	Hi	4	4	de Roy	Ry	8	29
Hartmann	Hf	14	21	Schenkman	Se	2	4
Houghton	Ht	72	179	Shinkfield	Sl	22	39
Hurahata	Hr	5	53	Shultz	Sz	6	6
Jones	Jo	113	414	Smith, F. P.	Sq	2	2
Kohman	Ko	39	75	Smith, F. W.	Sf	4	4
Lacchini	L	161	456	Smith, L.	Sh	3	6
Marsh	Ma	12	13	Smith, R.	Sr	2	4
McKnelly	My	10	20	Stearns	Sv	3	3
McLeod	Mc	19	114	Theile	Th	2	3
Meek	Me	85	188	Watson	Wa	1	2
Mennella	Mn	12	34	Webb	Wd	21	46
O'Byrne	Oy	8	11	Wright	Wr	4	6
Peltier	Pt	199	279				
Raphael	Ra	4	35	Totals		44	407	2768

the important calendar data, on the reverse side are contained the "International Symbols for the Constellations," "Tables for Converting Hours and Minutes to Decimals of a Day (4 places)," and "Tenths of Julian Day." Copies of this Calendar may be obtained upon application to the Recorder.

February 14, 1933.

LEON CAMPBELL, Recorder.

Comet Notes

By G. VAN BIESBROECK

COMET 1933 *a* (PELTIER). The first new comet of 1933 has first been announced by L. C. Peltier of Delphos, Ohio. This is the fourth comet discovered by this able observer, who is not contented with following variable stars most industrously and estimating brightnesses of comets but who in addition sweeps the heavens systematically for unexpected cometary visitors.

The new object was found during the night of February 15-16. The discoverer wired at once to the writer but the sky being cloudy here no position could be secured. The next morning Peltier sent the following information to the Central Bureau of telegrams at the Harvard College Observatory:

Comet Magnitude 8, Feb. 16: R.A. $22^h\,48^m$, Decl. $+62°$. Motion Southeast.

The next evening the writer had the opportunity to observe this object as a round coma about 5′ in diameter with only a vague indication of tail, the coma extending a little farther from the nucleus in the direction opposite to the sun. Two nights later there was already a marked decrease in brightness. The following observations made by the writer are the only ones available at the time of writing:

1933 0^h U.T.	α h m s	δ ° ′ ″	M
Feb. 17.05138	23 12 28.00	+61 49 54.7	9
18.04063	23 36 51.34	61 57 33.9	8.7
19.03668	0 2 10.23	61 48 31.7	9.4
21.18079	0 56 30.24	60 27 32.5	10.5

A first orbit has been computed by Anderson and Wyse (Berkeley, California)

from observations on February 17, 17 and 18. The result is as follows:

Perihelion passage	1933 Feb. 7.63 U.T.	
Perihelion to node	137° 51′	}
Longitude of node	313 0	} 1933.0
Inclination	84 55	}
Perihelion distance	$q = 0.998$ Astr. Units	

with the ephemeris:

1933 0^h U.T.	α h m s	δ ° ′	Br.
Feb. 21	0 52 39	+60 36	1.09
25	2 21 12	54 44	
March 7	3 23 17	46 6	
5	4 3 38	37 4	0.81

This shows that the comet, which was found in the constellation of Cepheus, moves rapidly through the constellation of Cassiopeia and through the densest part of Perseus. In the middle of March it will be in Taurus but the increasing distance will reduce the brightness.

Several of the comets that were under observation since last year have become too faint for further measure during the past month: they are Periodic Comets Kopff (1932 *e*) and Brooks (1932 *m*) as well as Comet 1932 *f* (Newman). A number of others will be followed sometime longer.

Since the end of January Comet 1932 *n* (Dodwell-Forbes) has decreased in brightness more rapidly than expected. At the same time it has become more diffuse and the tail has no longer been visible. From the longer interval of time covered by the measures it is now possible to confirm the deviation from parabolic motion already suspected by previous computers. A. D. Maxwell (Ann Arbor, Michigan) finds the following elliptic orbit which accurately represents the observations from December 19, 1932, to January 31, 1933:

Time of Perihelion	1932 Dec. 30.51633 U.T.	
Node to Perihelion	$\omega =$ 327° 19′ 40″.8	}
Longitude of node	☊ = 77 38 54.5	} 1933.0
Inclination	$i =$ 24 30 33.0	}
Perihelion distance	$q =$ 1.131018 A.U.	
Eccentricity	$e =$ 0.973560	
Period	$P =$ 279.8 years	

The corresponding new ephemeris is to be preferred to the one given last month (page 116):

1933 0^h U.T.	α h m s	δ ° ′	Distance from Earth	Distance from Sun	M
March 13	4 19 50	+35 42.6	1.47	1.59	12.5
17	34 51	36 49.8			
21	4 49 39	37 46.4	1.60	1.67	12.8
25	5 04 13	38 33.3			
March 29	18 31	39 11.4	1.74	1.76	13.1
April 2	32 31	39 41.4			
6	46 12	40 04.1	1.88	1.84	13.4
10	5 59 33	40 20.3			
14	6 12 34	40 30.6	2.03	1.93	13.7
18	25 13	40 35.6			
22	37 32	40 35.8	2.19	2.02	13.9
26	6 49 30	40 31.7			
April 30	7 01 07	+40 23.8	2.34	2.11	14.2

The magnitude has been added on the assumption that February 19 = $12^M.0$ as

observed by the writer, and that the decrease in brightness follows the law of inverse squared distances. It will be seen that the comet moves eastward across Perseus, enters the constellation of Auriga in the middle of March and stays there until the end of April. It is very doubtful, however, if it will remain visible as long as that.

Another evening object is PERIODIC COMET 1932*l* (FAYE) which is now passing through the constellation of Taurus. It is becoming quite inconspicuous and the tail is hardly visible any more. Later in the night PERIODIC COMET 1932*k* (BORRELLY) can be observed in Canes Venatici but it is no longer in reach of any but the larger telescopes. On February 3 it showed a small nucleus and a well-defined tail over a length of 5′ although the total brightness was not greater than that of a 15^{M} star.

Close watch has been kept both at Bergedorf, Germany, and Williams Bay, Wisconsin, of the faint PERIODIC COMET 1925 II (SCHWASSMANN-WACHMANN), whose unexpected outburst noted here on January 20 was mentioned last month. It lasted several days. On January 24 the image had the same appearance as four days earlier; and the brightness was, if anything, slightly greater. At first sight the object again appeared as a star on the plates but on closer scrutiny its edge showed a little fuzziness. When examined visually with the 40-inch on January 31 the comet showed again a coma some 40″ in diameter but there was still a strong central condensation. The total brightness had dropped to 14^{M}.5 and it continued to do so in February. On February 18 the central condensation was nearly lost in the faint coma, the total brightness being reduced to that of a 15^{M} star. Further watch is being kept on the curious behavior of this comet which will remain well situated for observation in the constellation of Cancer.

In the morning sky COMET 1932*g* (GEDDES) follows closely the ephemeris given on p. 118. On February 3 I estimated the magnitude as 10.5. The coma had a diameter of 3′ and there was a broad tail extending to half a degree from the nucleus. It is probable that this comet, which comes to opposition in the middle of April will remain observable for several months to come.

PERIODIC COMET PONS-WINNECKE has not yet been recovered, although the predicted region is conveniently placed. The search may have to be extended over a larger area.

Before the end of March PERIODIC COMET FINLAY may be picked up by the southern observers. It is due at perihelion about June 19 according to the ephemeris given by the British computers (*Brit. Astr. Association Handbook* for 1933).

Williams Bay, Wisconsin, February 21, 1933.

Meteor Notes from the American Meteor Society

By CHARLES P. OLIVIER, President

In last month's Notes was given the Annual Report of the Society, but since the report was compiled several lists of observations have arrived, some from other continents. These are briefly summarized below. The 215 meteors added to the total of 58,328 already reported makes a corrected total to date of 58,543. It is expected that a few more will arrive in the next month or two.

Name and Station	No. of Nights	No. of Meteors	Remarks
Chandra, R. G., Jessore, India		14	Casuals
		7	Telescopic
Dermul, Am., Antwerp, Belgium		9	Telescopic
Harwood, Miss M., Nantucket, Mass.	2	22	Group report: Lnids.
Westboro, Massachusetts	3	162	Leonid count by G.S. Thompson
Mory, Walter S., Waynesboro, Va.	1	32	Includes casuals. Previously reported, 33 on 2 Leonid nights.
Paterson, J. F., Broken Hill, Australia	1	11	Leonids
Ridley, G. W., Alameda, California	2	14	Previously reported, 1028 on 9 nights.
New Zealand Group:			
Auckland, New Plymouth, Wellington	4	27	Leonids
Additional fireballs		6	
		304	
Addition to previous report		—89*	
		215	

It will be our policy from now on to give brief reviews of important work done in meteoric astronomy, especially where our members may not have full access to the original papers. In the past few months two announcements of the greatest importance have been made, the first in a paper presented at the December meeting of the American Astronomical Society, the second in No. 588 of the *American Museum Novitates*, published also in December.

The first was by F. A. Melton and William Schriever of the University of Oklahoma. It described the results of a photographic survey of the Atlantic Coast between Savannah, Georgia, and Norfolk, Virginia, which disclosed, to the amazement of the observers, large numbers of elliptical rings, averaging twice as long as they are broad, all with major axes lying NW to SE. Some of these crater-like depressions have walls as much as 10 feet high, and some are fully 8000 feet long. They are unnoticeable from the ground. Many of them are crossed by roads and paths, and many are parts of cultivated farms.

Most interesting photographs were shown, and it was hard to realize that one was not looking upon lunar rather than terrestrial landscape. The number of the depressions and their regularity in outline, coupled with local geological studies and the vastness of the area covered, seemed to the authors of the paper to rule out all origins but an impact one. They believe that in some epoch geologically recent (not over 2,000,000 years at most) an immense comet hit our southeastern coastal regions. The object must have been several hundred miles in diameter. These "craters" are the last remains left by erosive forces of what were truly immense pits excavated by fragments of the comet. Obviously many fragments fell in the sea, and full surveys have not yet been made to any great distance inland.

This review is given from memory, as a reprint of the paper has not yet been received. It would therefore be premature to give any definite personal opinion further than to say that if additional studies confirm the impact origin of these formations, it will be of the utmost importance not only to meteoric astronomy but to theories of origin of the Solar System.

*Through a clerical error, R. A. McIntosh's totals were incorrectly given. His annual report should have been: 24 nights, 630 meteors. The additional 89 credited to him have been deducted from the total of the above table.

The second paper, No. 588 of the *American Museum Novitates*, by Charles B. Lipman of the University of California, is entitled "Are There Living Bacteria in Stony Meteorites?" The reprint has been received here and carefully read. Professor Lipman secured numerous specimens of stone meteorites, cleansed their surfaces in the most thorough manner by several chemical processes, let them stand for months in sterile media, then recleansed them, and finally broke them up in sterile mortars. Everything was done under such sterile conditions that he believes it impossible for bacteria to have entered during the experiments. When one has read the long list of elaborate precautions taken, one is inclined to agree in this conclusion. After the meteorite was pulverized, its powder was placed in culture flasks with sterile extracts, and incubation tried under carefully controlled conditions. For nearly all of the meteorites studied, some form of bacteria resulted. For instance, for the Johnstown Meteorite, of July 6, 1924, nine extracts were used to develop possible bacteria, two flasks of each extract being used simultaneously as a check. Two kinds of bacteria were grown in each flask of four extracts, and in one flask of the fifth.

In conclusion Professor Lipman frankly summarizes the principal arguments for and against his main conclusion—that bacteria *are* found in stony meteorites. Apparently his most serious adverse argument is No. 5: "While it was lying on the earth, and before being found, water with bacteria may have seeped into the meteorite." This he answers, however, by saying that for the Johnstown meteorite, at least, there was little or no contact with the earth, as it was picked up immediately after it fell. Some of the others also were picked up very soon after their fall, and he believes that the above objection cannot invalidate his results for such meteorites at least.

Should Professor Lipman's conclusions be confirmed by other scientists, it would surely be a discovery of epoch-making importance. Such researches will be eagerly awaited by all. A second paper by the same author (*American Museum Novitates* No. 589) gives the results of the analysis of seven stony meteorites for the presence of combined nitrogen. The percentages vary from 0.0064 to 0.0016, and the method of analysis employed indicates that the element is there in the form of organic nitrogen, and in amount and kind satisfactory for the need of the bacteria.

A paper by one of our own members, F. K. Smith of Glenolden, Pennsylvania, was read and favorably commented on at the December meeting of the Royal Astronomical Society, and appeared in the December *Monthly Notices*. It concerned the meteor orbits connected with the Pons-Winnecke Comet.

We welcome as new members the following:

R. A. Binckley, 143 Colfax Road, Upper Darby, Pennsylvania.
Phil F. Brogan The Bend Bulletin, Bend, Oregon.
P. W. A. Fitzsimmons, 1209 Washington Blvd., Detroit, Michigan.
Wm. Kenney, 140 Colonial Avenue, Freeport New York.
Robert Knabe, 1927 E. Hawthorne Street, Tucson, Arizona.
J. Fraser Paterson, Box 151A, Broken Hill, Australia.
Chas. Insco Williams, "Eglinton," King George, Virginia.

A.M.S. Bulletin No. 14 (Flower Observatory Reprint No. 16) has been mailed to every member. It contains the latest membership list and full information about the society. Flower Observatory Reprint No. 15 has also been sent to members who reported observations during 1932.

Flower Observatory of the University of Pennsylvania,
Upper Darby, Pennsylvania, 1933 February 16.

The Hour of the Leonid Maximum in 1932

By C. C. WYLIE

To determine the hour of Leonid maximum, it is desirable to use, as far as possible, observations by the same person, or group of persons. The best series of observations available are those at Pomona College, Claremont, California, where hourly counts were made on five successive nights, and those at Columbia College, Dubuque, Iowa, where counts were made on three nights, the other nights near maximum being cloudy. We give the counts on the three days when the most meteors were observed. The times are transferred to Greenwich mean astronomical time (G.M.A.T.) for uniformity.

Date	Hour	Leonids	Remarks
November 14	*23*:00-24:00	13	Claremont, clear sky
15	0:00- 1:00	33	Claremont, clear sky
	21:00-21:30	39	Dubuque, clear sky
	21:30-*22*:00	92	Dubuque, clear sky
	22:00-*22*:30	52	Dubuque, clear sky
	22:30-*23*:00	76	Dubuque, clear sky
	23:00-24:00	24	Claremont, thick haze
16	1:00- 5:00	5	Dubuque, *daylight*
	23:00-24:00	41	Claremont, fairly clear
17	0:00- 1:00	72	Claremont, clear

The fact that the Claremont counts on November 16-17 are distinctly higher than those at the corresponding hours on November 14-15 suggests that the Leonid maximum was nearer the counts of November 16-17. The Dubuque counts on November 15 (see these notes for January, 1933) show the greatest number of meteors, and the most bright meteors, in the fifteen minute period just before *22*:00. However, the number of meteors is high up to the time of interference from dawn, and the daylight meteors observed throughout the forenoon suggest that the maximum occurred after daylight for Americans, agreeing with the deduction from the Claremont counts. To fix the hour of maximum more closely, one should have similar counts from stations in the Pacific or Orient. Mr. R. A. McIntosh, New Zealand, reported five Leonids in a period of a little more than an hour, and states that this is more than he has observed on any previous maximum, even when the moon was absent. This indicates that a reasonably good display should have been seen from north of the equator where the radiant was higher. Mr. V. Malzev of Tashkent, U.S.S.R. (Russia) reported that his group observed through clouds, but that he believed the maximum occurred before November 16.3. Letters were addressed to various persons in Hawaii and the Orient, but no additional reports of value were received. The Dubuque and Claremont counts indicate a maximum after November 16.0, and Mr. Malzev believes from his observations through clouds that it occurred before November 16.3. It may have occurred earlier than our figure of November $16^d\,07^h$, published in these notes for February, 1932, but the estimate was undoubtedly within a few hours of the truth.

In the same article, we estimated the hour of maximum for 1933 as November 16^d13^h, G.M.A.T. If this is approximately correct, the best display in 1933 will be seen in longitudes between Tashkent, U.S.S.R. (Russia) and England. If, as appears possible, the maximum occurs a little earlier than our estimate, the best display will be seen somewhat east of these longitudes, perhaps in India and China.

People in the United States should see the beginning in the early morning hours of November 16, Civil Time, and the ending in the early morning hours of November 17, Civil Time. The best display will probably be seen by Americans on the latter date, that is, in the morning hours of November 17, as the radiant is high enough for a good view at about 3:00 A.M., eight hours after the time of predicted maximum. The moon will be within a day of new, so the display will be seen to better advantage than in 1932. As the maximum is sharp, probably few meteors will be seen on other than those two nights. Weather permitting, the European astronomers will no doubt see that this maximum is well observed.

In 1934, the estimated hour of maximum is November $16^d\,19^h$, G.M.A.T. This is 1:00 A.M. for persons in the central United States, and as the moon sets at about 3:00 A.M., the chances for an interesting display are good. Our estimates, therefore, favor Europeans having the best view in 1933 and Americans having the best view in 1934.

University of Iowa, February 23, 1933.

The Distribution of Meteorites

It would be a great asset if we had some rule of thumb that we could apply to the interpretation of data in order to decide which of several explanations should be considered the most deserving of our acceptance. Quite possibly we do have such a guide in the rules of reasoning in philosophy laid down by Sir Isaac Newton.[1] His fourth rule, which is the most important for the present occasion, is as follows: "In experimental Philosophy we are to look upon Propositions collected by general Induction from Phænomena as accurately or very nearly true, notwithstanding any contrary Hypotheses that may be imagined, till such Time as other Phænomena occur by which they may either be made more accurate, or liable to Exceptions." Newton considered this rule to be necessary in order that the argument of induction might not be evaded by hypotheses. In his work on optics[2] he repeats in substance the same idea as follows: "As in Mathematicks, so in Natural Philosophy, the Investigation of difficult Things by the Method of Analysis, ought ever to precede the Method of Composition. This Analysis consists in making Experiments and Observations, and in drawing general Conclusions from them by Induction and admitting of no Objections against the Conclusions, but such as are taken from Experiments, or other certain Truths. For Hypotheses are not to be regarded in experimental Philosophy."[2a] He declared this method to be that employed in the first two books of his *Opticks*. In the following discussion it is proposed to apply Newton's fourth rule to the problem of the distribution of meteorites in order to decide whether or not they are equally distributed over the surface of the earth.

The data as to the location of meteorite "finds" and "falls" have been carefully compiled. Taking Prior's *Catalogue of Meteorites* as an authority, I have prepared a map showing the distribution of meteorites in the United States. Similar ones might be prepared for Europe and for India. Each dot on the map represents the location of one meteorite. Let us compare the obviously unequal distribution shown on the map with the recorded opinions of astronomers. We soon find in the literature on the subject that most of them favor a theory of equal distribution. This view was set forth by Daniel Kirkwood in his *Meteoric Astronomy* (1867), and the same view seems to hold in one of the latest texts, that of Dr. Charles P. Olivier, *Meteors* (1925). In a personal letter another authority tells me that it is hard to imagine the distribution as being anything else than equal.

This opinion is an excellent example of the logical fallacy known as "begging the question," but the author of it in no way differs from other astronomers who quite generally, without offering any reason whatsoever, assume the distribution to be equal as, for example, in such statements as "There are three times as many meteors falling on the water surface of the earth as on land." The whole situation reminds me of a remark by Dr. John Dewey, "The natural tendency of man is not to press home a doubt, but to cut enquiry as short as possible."

Distribution of Meteorites in North America.

As a matter of fact, however, nothing could be more natural than to imagine the distribution to be unequal if we stick to the known facts and omit all hypotheses. Consider for a moment the great concentration of meteorites in western North Carolina and in eastern Tennessee, a district with a terrain making recovery of meteorites uncertain and with a scattered population, the members of which do not collectively have a reputation for being interested in scientific matters. According to Kirkwood the most meteorites actually recovered should be where the population is the densest, but one needs only to glance at the map to see that meteorites have been found very rarely near any of the more important popu-

lation centers in the United States. We can see from this that we can leave out of consideration those parts of the earth for which the data would naturally be incomplete and still find ourselves unable to support a theory of equal distribution save on the bases of hypotheses.

Indeed, there seems to be no evidence showing that meteorites should be equally distributed. It is more than likely that scholars have been misled by hypotheses, particularly that as to the origin of meteorites. Chladni, writing at the end of the eighteenth century, favored a cosmic explanation of their origin and that explanation ever since seems to have commended itself to many astronomers. If we go back of the *petitio principii* that befogs the subject, it would seem as though their reasoning must be somewhat as follows: Meteoric matter originates outside the solar system (or at least outside the earth-moon system), therefore it is a matter of chance what part of the earth encounters the meteor in its flight through space, or in other words the distribution should be about equal. Since *a priori* reasoning to have validity must be based upon undisputed truths, it is only necessary to point out that this putative explanation disregards what little information we do have as to the organization of outer space, particularly the fact that there is apparently a fundamental plane of stability around the earth (as well as around other heavenly bodies), whose possible action upon meteoric bodies, if we do not forget that we really know very little as to the nature of gravitation, may be regarded as an open question. It might be added, however, that the problem as to the origin of meteorites is by no means settled, and among the possible explanations I suggest that they represent material from radiants, which has been collected in secondary condensation centers[4] in the earth-moon system from which centers they have been ejected by planetary or other perturbations.

There are certain additional astronomic facts having a bearing on this problem, which are usually overlooked. One of these concerns the suggestion that sun-spots may be due to showers of meteors falling upon the sun, and sun-spots are known, of course, rarely to occur above 40 degrees in latitude on either side of the sun's equator while the spots also avoid a space of about 10 degrees on each side of the equator. Whether this explanation of the origin of sun-spots be correct or not, at least the distribution of the spots may be related to the organization of space around the sun while a distribution of meteorites on the earth, similar to that of spots on the sun, may be related to a somewhat similar organization of space around the earth. Another bearing on the problem is the evidence presented by Capt. T. J. J. See, showing that craters on the moon may be caused by meteors. Lunar craters undoubtedly do have a strong resemblance to the meteoric crater at Coon Butte, Arizona. It is important to note that they are very unequally distributed upon the moon. In some lunar areas, as for instance near the south pole, there are a great many craters while other large areas have practically none. From these two instances it appears that some astronomers have been able to imagine an unequal distribution of meteors at least in the case of the sun and the moon.

In addition to the unequal distribution it is also of interest to observe whether there are any anomalies in the distribution over particular areas. Examining the map of the United States, I found a sort of lane extending from Puget Sound to the mouth of the Mississippi River, in which there were no "finds" or "falls" except for a small group in Colorado. Turning to the data for Europe and India, I found examples of the same thing, the general direction of the "lanes" being about northwest to southeast in each case. I have also studied the distribution in

the southern part of South America, in South Africa, and in Australia, and, while the data seemed insufficient, there were some indications of southwest to northeast "lanes" in those areas. Taking the distribution as a whole, it would seem to indicate a general movement of meteors (at least those resulting in meteorites) in the same direction as the rotation of the earth and also a movement towards the equator. And Carrington, by the way, has noted a movement of sun-spots towards the sun's equator within the latitudes of 20 degrees. The fact that meteors which reach the earth as meteorites are to be seen in the last stages of their flight moving in various directions proves nothing, for we know that the smaller meteors during their visible flight frequently have erratic or irregular orbits. This latter condition may be still more true of all classes of meteors in respect to their flight before they become visible. It is as though the meteors, while in general moving northwest to southeast over the United States, Europe, and India, were caught frequently by certain cross-currents and eddies which modified the direction of their movement just before their impact with the earth. It would seem that matter moves so slowly even at its greatest velocities in comparison with certain perturbative or gravitational influences that it must readily yield to those forces. At any rate whatever the meaning of these meteorite "lanes" may be, they are apparently what Herschel would call residual phenomena and as such require careful study.

The main purpose of this paper is to show that meteorites, contrary to accepted views, are unequally distributed upon the earth. It seems impossible to escape this conclusion by a rigorous application of Newton's rule. It is futile to urge that there are insufficient data for I am not attempting to settle this question for all time but rather in the Newtonian manner which is to form conclusions on the basis of the available data and then leave the results to be changed in the future, if that should prove necessary, on the basis of more complete information. In the terminology of the formal logicians I have used the method of *imperfect induction*, for not all possible cases having a bearing on the problem were available, hence my conclusion can be not certain but probable. On the other hand we are prohibited from using *a priori* or deductive reasoning by the lack of undisputed truths on which to base them.

NOTES.

The map of the "Distribution of Meteorites in North America" is based upon Dr. O. C. Farrington's *Meteorites* (1915), to which a few additional meteorites have been added, bringing the map up to date.

[1] *Principia*, 3rd ed. trans. by Andrew Motte, New York, 1848, Book III, p. 384.

[2] *Opticks*, reprint from 4th ed. (1730), New York, 1931, Book III, 31st Qu., p. 404.

[3] Newton himself used hypotheses but it is his distinction that he gave precedence in his reasoning to the actual phenomena over mere hypotheses. His strong feeling against hypothetical reasoning unsupported by facts led him to make an overstatement of his position in his famous remark "Hypotheses non fingo."

[4] This may be regarded as an extension of the Chamberlin-Moulton idea of "condensation centers" where planetesimals collect in order to form the planets, but the genesis of the idea is different.

Seattle, Washington. J. B. PENNISTON.

Leonid Observations for 1932 at Pomona College, Claremont, California

Organized visual observations of the Leonid meteors by student groups of Pomona College were continued from 11:00 P.M. to daylight beginning on November 12 and terminating on November 20, 1932. Photographic observations were also made simultaneously from three different stations.

The weather was generally clear with only slight interference from clouds

mostly of the high cirrus type. One notable and unfortunate exception occurred on the night of the 15th-16th which was nearly clear for only a short interval between 2:00 A.M. and 3:00 A.M. At other times the clouds varied from a thickness sufficient to obscure the moon's disk to a generally overcast sky which permitted only the brightest objects such as Mars, Jupiter, and Regulus to be visible. Perhaps the brightest Leonid seen in this vicinity on any of the nights appeared at about 4:41 A.M., Pacific Standard Time, and crashed through this thick haze.

On the morning of the 16th Leonids were observed at the rate of 40 to 50 per hour during the clearest intervals. On the following morning of Thursday the 17th a clearer sky permitted an increase in the observed rate and as many as 70 per hour were reported in the later morning hours.

A comparison of Leonid totals from night to night shows that the count rose more rapidly than it subsided if allowances are made for differences in weather conditions. This would seem to suggest a greater concentration of meteor bodies along the inner side of the stream. Such a conclusion, however, must await confirmation from observations at more than one locality.

Reports have been received as requested from interested individuals all over southern California giving their counts of meteors. In the student groups also "solo" observers kept their individual counts separately from those of the group. This procedure was suggested by Dr. C. C. Wylie as giving a more universal basis for comparisons. These "solo" counts differ but slightly from the counts obtained by the group observers, doubtless because the moonlight submerged all but the brightest objects.

The photographic program involved three stations forming a triangle with airline distances of from 20 to 25 miles. One was located at the Brackett Observatory at Pomona College, the second through the kindness of Mr. A. F. Moore was placed on the grounds of the Smithsonian Observatory on Table Mountain, almost due north from the first. The third through the kind offer of Dr. S. B. Nicholson was made available on Mt. Wilson. Fast Cooke lenses for the Claremont and Table Mountain stations were provided through the courtesy of the Eastman Kodak Stores, Inc., of Los Angeles.

Sensing these preparations the meteors failed to provide the expected display either as to numbers or brilliancy. The photograph of only one brilliant Leonid and the lesser trails of several others rewarded the long vigils at the cameras and may provide some material from which heights above the earth's surface may be computed for some of these objects. It was hoped that enough trails might be photographed to provide also a precise determination of the radiant or radiants associated with the Leonid stream but the failure of any considerable display precludes the possibility. The presence of the moon near the full interfered seriously with the photographic and the visual programs alike.

The visual observations appear in tabulated form below:

LEONID OBSERVATIONS FOR 1932 AT POMONA COLLEGE.

		Total	Leonid	Weather
Nov. 12-13	11:00 p.m. to 4:00 a.m.	11	4	Clear
13-14	11:00 p.m. to 4:00 a.m.	7	3	Clear
14-15	11:00 p.m. to 1:00 a.m.	5	1	Clear
	1:00 a.m. to 2:00 a.m.	5	5	Clear
	2:00 a.m. to 3:00 a.m.	16	12	Clear
	3:00 a.m. to 4:00 a.m.	14	13	Clear
	4:00 a.m. to 5:00 a.m.	34	33	Clear
	Leonid total.....		64	

		Total	Leonid	Weather
Nov. 15-16	11:00 p.m. to 1:00 a.m.	3	3	Clouds to thick
	1:00 a.m. to 2:00 a.m.	10	8	haze all night.
(clearer)	2:00 a.m. to 3:00 a.m.	46	41	Few clear
	3:00 a.m. to 4:00 a.m.	27	24	spells.
	4:00 a.m. to 5:00 a.m.	16	15	
	Leonid total.....		91	
Nov. 16-17	11:00 p.m. to 1:00 a.m.	3	3	Part cloudy
	1:00 a.m. to 2:00 a.m.	6	4	early.
	2:00 a.m. to 3:00 a.m.	20	15	Cleared later.
	3:00 a.m. to 4:00 a.m.	46	41	
	4:00 a.m. to 5:00 a.m.	84	72	
	5:00 a.m. to 5:47 a.m.	75	66	
	Leonid total.....		201	
Nov. 17-18	12:00 a.m. to 1:00 a.m.	9	5	Clear
	1:00 a.m. to 2:00 a.m.	11	5	Clear
	2:00 a.m. to 3:00 a.m.	11	6	Clear
	3:00 a.m. to 4:00 a.m.	10	7	Clear
	4:00 a.m. to 5:00 a.m.	6	4	Clear
	5:00 a.m. to 5:30 a.m.	5	4	Clear
	Leonid total.....		31	
Nov. 18-19	11:00 p.m. to 1:00 a.m.	7	1	Clear
	1:00 a.m. to 2:00 a.m.	13	6	Clear
	2:00 a.m. to 3:00 a.m.	14	9	Clear
	3:00 a.m. to 4:00 a.m.	12	6	Clear
	4:00 a.m. to 5:00 a.m.	3	3	Clear
	Leonid total.....		25	
Nov. 19-20	12:00 a.m. to 2:00 a.m.	5	2	Clear
	2:00 a.m. to 4:00 a.m.	9	6	Clear
	Leonid total.....		8	

Notes from Amateurs

The Chicago Amateur Telescope Makers did not hold a regular meeting at the Adler Planetarium the first Sunday in February but instead were the guests of Dr. Lee at the Dearborn Observatory at Evanston, Illinois. It was a cloudy evening so Dr. Lee showed a number of plates taken with a Cooke lens, ten and a half inches aperture, attached to the large refractor. The plates were of spctra, more than eight hundred appearing on many of the plates. Dr. Lee is especially interested in red stars and showed us a number of beautifully banded spectra. Some plates of the last apparition of Eros were shown, the instruments of the observatory explained, and a description of the work of the forthcoming longitudinal survey net that will be made this coming season in coöperation with the Geodetic Survey was given.

WM. CALLUM, *Secretary.*

1319 W. 78th Street, Chicago, Illinois.

Astrolab

If you haven't a telescope and would like one, if you have partially finished one and had to postpone its completion because of lack of information, materials,

or parts—in other words if you are very much interested in astronomy and optics and would like to work with others of us on the same problems we should like to hear from you.

Astrolab is a group without national or state boundaries organized for the advancement through coöperative effort of Amateur Telescope Making, and through the making of better instruments available at a lower cost to increase interest in astronomy and astrophysics.

The Astroscopes so far issued under Astrolab are: "Organization Issue and Who's Who Questionnaire," "General Report and Abstracts of Some of Replies to Questionnaire," "Eyepieces, Prisms, and Diagonals."

For other information see previous issues of POPULAR ASTRONOMY and write for Astrolab membership details. For the Organization Issue of the "Astroscope" inclose some stamps to share cost and we shall gladly send it to you.

L. I. BUTTLES, Editor of *The Astroscope*.

10728 S. Artesian Avenue, Chicago, Illinois, February 12, 1933.

Aldrich Astronomical Society

A new society of amateur astronomers has recently been organized under the above name, at Worcester, Massachusetts. The membership is divided into groups who are interested in observational as well as mechanical projects. The observers are divided into variable star, meteor, and occultation groups, and most of the members of these groups are also interested in the constellation classes. The chief item of interest among the mechanical projects is the construcion of reflector telescopes.

As a part of the educational program of the society a series of lectures on elementary astronomy is given at the Museum of the Natural History Society which is also the headquarters for the Astronomical Society. Our first regular lecture was given by Dr. Charles H. Smiley of the Ladd Observatory in Providence, Rhode Island, and programs are arranged for the balance of the present season. A feature of our programs consists in two or three five-minute papers which are given by the members in addition to the main lecture, these lectures covering certain technical points, as well as biographical sketches and items of current interest. We have about seventy-five persons who have shown an interest in the work of the Society and this number is growing steadily.

The organization was named in honor of Professor Fred Aldrich of the Worcester Academy in this city. The officers are as follows: Mr. Walter H. Wakefield, president; Mr. George J. Knoll, Jr., vice-president; Mr. Frank H. Davidson, treasurer; Miss Ruth I. Gould, secretary; Miss Elizabeth Allen, librarian; Mr. Charles J. Hudson, technical advisor.

Zodiacal Light Notes

By W. E. GLANVILLE

JAPAN.—From Professor Yamamoto, Director, Kwasan Observatory, Kyoto, Bulletins 227 and 237 have been received. Bulletin 237 reports a conference of the Zodiacal Light Section held last July 20 and 21. Arrangements were made for reporting simultaneous observations, magnetic conditions and relation between the Zodiacal Light and the Sunspot Cycle. Also, photographic work will be undertaken "with cameras having lenses of F4.5 or brighter, the standard size of the

plate being 11 cm x 8 cm; these photographs should be auxiliary to visual observations." Bulletin 227 lists a number of observations not previously reported, 49 for the evening and 11 for the morning. The Section observers live in various parts of the empire between latitudes 33° and 43°. A feature of the reports is the surprising difference in position and extent of the Light on the same evening or morning, at approximately the same hour and under good weather conditions, as observed from different stations. Also, inland observers of the evening Light find its color mostly yellowish white while coastal observers find it mostly white and the morning observers, with one exception, find the color predominantly white. Of the 49 evening observations, pulsations and variations were recorded in 18 instances; of the morning observations, pulsations and variations were seen in 6 instances. The term "variations" means variations in the intensity of the Light; the term "pulsations" means a wavering or quivering of the Light independently of variations present or absent. The Section is to be congratulated on its continued enthusiastic interest under the able leadership of Mr. Kenzi Araki.

Australia.—Mr. J. Fraser Paterson, Broken Hill, N.S.W., latitude 32° S, sends reports of 16 evening observations in November and December. On November 17 it was not visible, sky very clear. On November 23 and 24 the apex reached the Pleiades. On November 25 at 9:15 P.M. he saw it easily but at 9:30 it disappeared suddenly. On December 20 it was again invisible. On December 24 he found it very faint at 9:30. At 1:30 A.M. he noticed the midsummer glow around the *south geographic pole*. On December 25, 26, 27, 28 the Light was faint but on December 29 and 30 it was brighter with apex at Aldebaran.

Yerkes Observatory.—Last fall Dr. C. T. Elvey studied the Gegenschein by two methods. First, he measured the intensity with a photoelectric photometer attached to the 40-inch telescope. He estimated the central brightness as equivalent to a sixth magnitude star per square degree. His report is published in the January *Astrophysical Journal*. The second method was photographic; the data are still under discussion and it is expected that the results will be published soon.

Evening Zodiacal Light.—Mr. Stuart L. O'Byrne, Webster Groves, Missouri, made five observations in January. On January 14, 7:30 P.M., the Light was plainly visible in Aquarius and Pisces with apex between Epsilon and Delta in Pisces. The north boundary passed through Gamma in Pisces and Alpha in Aquarius. The south boundary was straight, passing 3½° north of 33 Pisces and through Delta in Aquarius. On January 19 at 6:30 the Light near the horizon was brighter than the galaxy in Cygnus but the boundaries were indistinct. At 6:50 the north boundary had moved about 1½° north from its first position and a narrow band was seen through the western part of Aries. On January 22 a shift of the north boundary was again noticed between 6:40 and 7:15, together with a band ending near the Pleiades. The central line was definitely north of the ecliptic. On January 23 and 25 the visibility was poor and the boundaries were most diffuse.

On January 19, 20, 24, 26, and February 12 the writer made observations. On January 19 at 7:00 P.M. the apex was seen south of Gamma in Aries. The central line was north of the ecliptic. On January 20 at 7:45 Delta in Pegasus was on the north boundary. Near the horizon the general brightness was equal to the galaxy between Cygnus and Cassiopeia. At 8:30 no trace of the Light was seen. On January 24 and 26 special attention was given to the disappearance of normal twilight. On both evenings at 6:20 the sky east of the meridian was dark. West of the meridian considerable twilight, broadening to the horizon, remained, the

space between the lowest third of the Pegasus Square and Beta in Cetus being covered. Until 6:45 the Light area continued to contract until, finally, only the familiar form of the Zodiacal Light was left, the apex pointing directly to the Aries stars. On February 12 between 7:15 and 7:25 the north boundary passed through Alpha in Pegasus and slightly south of Gamma. With apex near the Pleiades the south boundary passed about 3° north of Delta in Aquarius. The whole body was quite broad as far as Aries and in color was conspicuously brownish or smoky.

Morning Zodiacal Light.—On January 29 and 30 the Light was observed between 5:15 and 5:30. From Scorpio low on the horizon to Spica it was faint. It filled the space between Alpha and Beta in Libra which marked its average breadth except along the horizon where it commingled with the Milky Way.

Gegenschein.—Attention is again asked to observations of the Gegenschein during the March equinox. Reports will be very welcome. Determination of the center is made by noting the intersection of the two diameters, east and west and north to south. Concerning the seaonal changes in the shape and size of the Gegenschein as between the equinoxes and the solstices the suggestion has been received that they may be attributed to the fact that at the equinoxes when the sun is on the equator the fullest extent of the Light is visible the sun, earth, and Gegenschein then being in direct line, whereas at the solstices the Gegenschein is, as it were, on a slope which gives it a foreshortened and oval appearance.

The Rectory, New Market, Maryland.

General Notes

Professor H. Ludendorff has been chosen president of the Astronomische Gesellschaft to fill the vacancy caused by the death of Professor Max Wolf.

Professor Ormond Stone, retired from the directorship of the Leander McCormick Observatory of the University of Virginia in 1912, was instantly killed on January 11, 1933, when struck by an automobile near Fairfax, Virginia. An account of his contributions to astronomy will be published in a coming issue of this magazine.

The Chicago Astronomical Society held its February meeting on Wednesday, February 8, 1933, at eight o'clock, at the Adler Planetarium and Astronomical Museum. Professor H. T. Stetson, Director of the Perkins Observatory of Ohio Wesleyan University, gave an illustrated lecture on "Solar Radiation and Radio Transmission." Dr. Stetson also described the new Observatory and its equipment, including the great 69-inch reflector.

The Rittenhouse Astronomical Society held its monthly meeting at 8:00 P.M., Tuesday, February 14, 1933, in the hall of The Franklin Institute, 15 South Seventh Street, Philadelphia. The speaker was Dr. Harlan T. Stetson, Director of Perkins Observatory, Ohio Wesleyan University, his subject being "Some Coming Problems in Cosmic Astronomy."

A Steward Observatory Fellowship will be available for the academic year 1933-34. The stipend will be approximately $600.00. About one-half of the time of the holder may be requested for services to the Observatory, but such work

is expected to concern itself with observatory duties rather than with teaching, and time devoted to the fellow's special work will ordinarily be counted toward this observatory service. Opportunity will be offered for investigation particularly in the field of Nebulae and Photometry with the 36-inch reflecting telescope. Requests for application blanks should be addressed to Professor A. E. Douglass, Director of the Steward Observatory, Tucson, Arizona, and should be accompanied by the applicant's academic record.

Lunar Appulses, 1933

The year 1933 has no eclipses of the moon. This means that the moon's celestial latitude at the times of the various full moons throughout the year is sufficiently high to altogether miss the earth's umbra. However, if we investigate the full moons on each side of the two solar eclipses of the year, which occur on February 24 and August 21, we shall find that the moon traverses the earth's penumbra to the extent of three times. In other words, there are three lunar appulses in 1933.

To compute the angular radius of the earth's penumbra at any time, we add together the sun's semidiameter, the sun's horizontal parallax, and the moon's horizontal parallax. To this computed radius we then add the moon's semidiameter, and if the moon's celestial latitude at full moon is greater than this sum value, no appulse can occur. But if the moon's celestial latitude at full moon is less than the aforementioned sum, an appulse must occur, and if the moon's latitude is sufficiently low, a lunar eclipse may occur.

The computation of the 1933 appulses was done by a graphic method, since an observation of a lunar eclipse is rather indefinite due to the indistinctness of the edges of the earth's umbra and penumbra. The computed results, accurate to single minutes of time and position angles to single minutes of arc are much more accurate than the actual phenomena could be observed.

The magnitude of appulse is rather low in all the 1933 appulses and it will require sharp watching to detect changes in illumination of the lunar surface as it passes into the penumbra. Close appulses show much more variation in shading when the moon passes quite close to the unbral edge.

The appulse of March 12 follows the solar eclipse of February 24 by about two weeks. The appulse of August 5 precedes the solar eclipse of August 21 by about two weeks, and the appulse of September 4 follows the same solar eclipse by about the same interval.

Th circumstances of the 1933 appulses are as follows: (G.C.T.)

1933		Begins h m	Angle from North	Middle h m	Ends h m	Angle from North	Mag.
March	12	0 45	67° E	2 32	4 17	9° W	0.61
August	5	18 36	2° E	19 45	20 53	46° W	0.24
September	4	3 00	111° E	4 51	6 43	167° W	0.73

The moon is in the zenith at midphase in the various appulses as follows:

1933 March	12	Long. 54° W	Lat. + 2°
August	5	Long. 80° E	Lat. —18°
September	4	Long. 90° W	Lat. — 6°

The August appulse is, therefore, not visible in North America.

The term "Magnitude of appulse" is used to denote the per cent of the moon's apparent diameter which dips into the penumbra.

RALPH C. LOWE.

Media, Pennsylvania.